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October 31, 2002
L-02-106

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: Beaver Valley Power Station, Unit No. 1 and No. 2
BV-1 Docket No. 50-334, License No. DPR-66
BV-2 Docket No. 50-412, License No. NPF-73
License Amendment Request Nos. 299 and 171

Pursuant to 10 CFR 50.90, FirstEnergy Nuclear Operating Company (FENOC) hereby requests to amend Facility Operating Licenses DPR-66 and NPF-73 for Beaver Valley Units 1 and 2. The proposed amendments revise Unit 1 and Unit 2 Technical Specifications Section 6.17, Containment Leakage Rate Testing Program, to allow a one-time 5 year extension to the current 10-year test interval for the containment integrated leak rate test (ILRT). Beaver Valley Power Station has implemented the 10 CFR 50, Appendix J, Option B performance-based containment leak rate test program.

The proposed changes are submitted on a risk-informed basis as described in Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis." The proposed changes to extend the ILRT surveillance interval are justified based on a combination of risk informed analysis and assessment of the containment structural condition utilizing ILRT historical results and containment inspection programs. The risk aspects of the justification have been prepared using the methodology contained in WCAP-15691, "Joint Applications Report for Containment Integrated Leak Rate Test Interval Extension," Revision 4, September 2002. WCAP-15691, Revision 4 was submitted to the NRC for review by CEOG letter CEOG-02-195 dated October 25, 2002. The Beaver Valley plant-specific risk-informed supporting analyses are presented in Appendices F and G of WCAP-15691. These appendices are also included in this amendment request as Enclosures 2 and 3.

The risk-informed supporting analysis demonstrates that the increase in risk of extending the ILRT interval from 10 to 15 years is insignificant. This analysis, done in

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accordance with Regulatory Guide 1.174, shows that the increase in total plant risk due to the extended ILRT interval is 0.005 percent for Beaver Valley Unit 1 and 0.02 percent for Beaver Valley Unit 2. The delta-large early release frequency is only 1.91E-9/yr and 1.35E-9/yr, respectively, for Beaver Valley Unit 1 and Unit 2. WCAP-15691 demonstrates that, from a risk perspective, an extension in the interval out to 20 years has an insignificant impact on risk. This is consistent with the findings of NUREG-1493, "Performance Based Containment Leak-Test Program." This submittal requests only a one-time interval extension from 10 years to 15 years.

This License Amendment Request contains five enclosures. Enclosure 1 is the FENOC evaluation of the proposed changes. This enclosure has three attachments. The proposed Technical Specification changes are provided in Attachments A-1 and A-2 for Units 1 and 2, respectively. Commitments associated with this request are provided in Attachment B. Enclosures 2 and 3 provide the risk-informed supporting analyses for Units 1 and 2, respectively, as discussed above. Enclosures 4 and 5 provide a sensitivity evaluation comparing the WCAP-15691 methodology results with those obtained using the previously approved Florida Power Corporation Crystal River Unit 3 (CR3) methodology.

The Beaver Valley review committees have reviewed this change. The change was determined to be safe and does not involve a significant hazard consideration as defined in 10 CFR 50.92 based on the attached safety analysis and no significant hazard evaluation.

FENOC requests approval of the proposed amendment by February 21, 2003, to support the spring 2003 refueling outage for Beaver Valley Unit 1. Once approved, the amendment shall be implemented within 60 days.

If there are any questions concerning this matter, please contact Mr. Larry R. Freeland, Manager, Regulatory Affairs/Performance Improvement at 724-682-5284.

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 31, 2002.

Sincerely,

Marc P. Pearson

Marc P. Pearson

Enclosure 1 FENOC Evaluation of the Proposed Changes

Attachments:
A-1 Proposed BVPS Unit 1 Technical Specification Changes (mark-ups)
A-2 Proposed BVPS Unit 2 Technical Specification Changes (mark-ups)
B Commitment Summary

Enclosure 2 WCAP-15691, Appendix F

Enclosure 3 WCAP-15691, Appendix G

Enclosure 4 Sensitivity Evaluation Comparing the WCAP-15691 Methodology to the Previously Approved CR3 Methodology for BVPS Unit 1

Enclosure 5 Sensitivity Evaluation Comparing the WCAP-15691 Methodology to the Previously Approved CR3 Methodology for BVPS Unit 2

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Central File - *Keywords:* *LAR, Containment, Type A Leak Test, Integrated Leak Rate Test, ILRT*

ENCLOSURE 1
FENOC Evaluation of the Proposed Changes

Beaver Valley Power Station
License Amendment Requests
299 (Unit 1) And 171 (Unit 2)

Subject: One-time Extension of the Type A Containment Integrated Leak Rate Test (ILRT) Interval from 10 years to 15 years

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Attachments

1.0 DESCRIPTION

This is a request to amend Operating Licenses DPR-66 (Beaver Valley Power Station Unit 1) and NPF-73 (Beaver Valley Power Station Unit 2).

The proposed change will revise the Operating Licenses to allow extending the Type A Containment Integrated Leak Rate Test (ILRT) interval from 10 years to 15 years on a one-time basis.

2.0 PROPOSED CHANGES

The proposed Technical Specification changes, which are submitted for NRC review and approval, are provided in Attachments A-1 and A-2 for Units 1 and 2 respectively. Attachment B provides a list of commitments associated with this License Amendment Request (LAR).

The proposed changes to the Technical Specifications have been prepared electronically. Deletions are shown with a strike-through and insertions are shown double-underlined. This presentation allows the reviewer to readily identify the information that has been deleted and added.

Changes to the following Technical Specifications (TS) are being proposed to allow extending the Type A Containment ILRT interval from 10 years to 15 years on a one-time basis.

Affected Technical Specifications			
Change	**Unit 1**	**Unit 2**	**Title**
1	6.17	6.17	Containment Leakage Rate Testing Program

The following provides a description of the proposed changes and a basis for the changes.

<u>Change No. 1</u>

The proposed change to Specification 6.17 will allow extending the Type A Containment ILRT interval from 10 years to 15 years on a one-time basis, by adding an exception to the commitment to follow the guidelines of

Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program," September 1995, (Reference 1). This exception is based on the information in NEI 94-01, "Industry Guideline for Implementing Performance Based-Option of 10 CFR50 Appendix J," July 1995 (Reference 2), and will be an extension of the currently specified 10-year interval (from the last ILRT) to a 15-year interval on a one-time basis.

Basis for Change No. 1

The proposed changes are submitted on a risk-informed basis as described in Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Current Licensing Basis," (Reference 3). The proposed changes to extend the ILRT surveillance interval are justified based on a combination of risk informed analysis and assessment of the containment structural condition utilizing ILRT historical results and containment inspection programs. With regard to risk, only the impact of the ILRT interval extension on large early release frequency (LERF) is considered, since the Type A test does not impact core damage frequency (CDF). The risk analysis was performed consistent with the methodology contained in WCAP-15691, Rev. 4, "Joint Applications Report for Containment Integrated Leak Rate Test Interval Extension," September 2002 (Reference 4). WCAP-15691, Rev. 4, was submitted to the NRC by CEOG letter CEOG-02-195 dated October 25, 2002. A brief description and history of the BVPS Units 1 and 2 Type A test results are discussed in Appendices F and G of WCAP-15691, Rev. 4. Appendices F and G are included as Enclosures 2 and 3 respectively to this LAR. A more detailed description is provided in this LAR.

WCAP-15691, Rev. 4 provides the risk-informed analysis to demonstrate that the increase in risk of extending the ILRT interval from 10 to 15 years is insignificant. The risk analysis, which was performed in accordance with Regulatory Guide 1.174 shows that the increase in total plant risk due to the extended ILRT interval of 15 years, is 0.005 percent (Unit 1) and 0.02 percent (Unit 2). The delta-LERF is 1.91E-9 /yr (Unit 1) and 1.35E-9 /yr (Unit 2) when the test interval is increased from 10 to 15 years. These delta-LERF values meet the Regulatory Guide 1.174 acceptance criterion of less than 1.0E-07 per year for LERF. Additionally, Enclosures 2 and 3 also demonstrate that an extension in the interval out to 20 years has an insignificant impact on risk. This is consistent with the findings of NUREG-1493, "Performance Based Containment Leak-Test Program," September 1995 (Reference 5). This LAR only requests a one-time interval extension from 10 to 15 years.

3.0 BACKGROUND

Existing Design Basis

The BVPS Units 1 and 2 containment buildings are subatmospheric containment types, with a containment operating air partial pressure range of 8.9 psia to 10.5 psia for Unit 1 and 9.0 psia to 10.5 psia for Unit 2. A License Amendment Request was submitted to the NRC by FENOC letter L-02-069, dated June 5, 2002, "Beaver Valley Power Station, Unit No. 1 and No. 2, License Amendment Request Nos. 300 and 172," (Reference 6) with a proposed change to operate BVPS Units 1 and 2 with atmospheric containments.

Each containment structure is a totally reinforced concrete, steel lined vessel with a flat base, cylindrical walls, and a hemispherical dome. The foundation mat is a soil bearing concrete slab approximately 10 feet thick. The inside faces of the containment wall, dome and mat are lined with steel liner plates which act as a leak-tight membrane.

The cylindrical portion of the liner is 3/8 inches thick, the hemispherical dome liner is 1/2 inches thick and the floor liner covering the mat is 1/4 inches thick. The floor liner plate is covered with a thick layer of reinforced concrete that insulates it from temperature effects. All welded seams in the mat, cylindrical liner wall and hemispherical dome and liner penetrations are covered with continuously welded test channels. These channels were used to check leak tightness of the welds during liner erection. Test ports and 1/8-inch NPT pipe plugs are provided for each zone of test channels. The test port plugs remain in place during normal operation and subsequent Type A Leak Rate Testing. The test channels for the cylindrical wall and penetrations are mounted inside the containment structure. The test channels for the dome area are mounted on the exterior of the dome liner. The test channels for the containment floor liner plate are covered with concrete with test ports that extend up to the containment concrete floor. The test channels are capable of withstanding all loads that could be imposed upon them during normal and upset conditions without impairing the performance of the containment liner itself and provide additional protection in the form of a redundant barrier to the steel liner welds.

The testing requirements of 10CFR50 Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," (Reference 7) provide assurance that leakage through the containment, including systems and components that penetrate containment does not exceed design values anticipated up to and including the design basis accident. The integrated leakage rate test (ILRT), or Type A test as referred to in 10CFR50 Appendix J, is primarily an overall test of the containment structure.

10CFR50 Appendix J was revised effective October 26, 1995 to allow use of Option B, Performance-Based Requirements. Regulatory Guide 1.163, provides an acceptable method for compliance with the performance-based option. RG 1.163 endorses NEI 94-01, including the criteria for test interval selection.

NEI 94-01 specifies an initial Type A test interval of 48 months, but allows an extended test interval of 10 years, based on two consecutive successful tests. Based on the last two consecutive ILRTs, the current surveillance interval for both BVPS Units 1 and 2 is 10 years.

The NRC acceptance of a change from the previous frequency of 3 times in 10 years to once in 10 years was based on NUREG-1493. NUREG-1493 stated that reducing the frequency to once in 20 years between tests would lead to an imperceptible increase in risk. Currently discussions are in progress between the NRC and NEI concerning a permanent extension of the 10-year ILRT test surveillance interval. A one time change based on a plant specific assessment would defer the immediate requirement for the ILRT and will allow time for acceptance of an industry wide change to the surveillance interval through a revision to NEI 94-01.

Several requests have been approved by the NRC for the one time surveillance interval extension to 15 years for the Type A test. This proposed change and associated methodology used to justify the change is consistent with that approved for Waterford Unit 3, "Waterford Steam Electric Station, Unit 3 - Issuance of Amendment Re: Integrated Leakage Rate Testing Interval Extension (TAC No. MB2461)," dated February 14, 2002 (Reference 8), and for Calvert Cliffs Unit 1, "Calvert Cliffs Nuclear Power Plant, Unit No. 1 - Amendment Re: One-Time Extension of Appendix J, Type A, Integrated Leak Rate Test Interval and Exception from Performing A Post-Modification Type A Test (TAC No. MB3929)," dated May 1, 2002. (Reference 9).

Proposed Changes to Design Basis

The proposed change to Specification 6.17 will allow extending the Type A Containment ILRT interval from 10 years to 15 years on a one-time basis, and will not impact the ability of the containment to perform as assumed in the safety analyses. No changes to the containment design are associated with the proposed change in the ILRT interval extension. The risk analysis, which was performed in accordance with Regulatory Guide 1.174 shows that the increase in total plant risk due to the extended ILRT interval of 15 years, is 0.005 percent (Unit 1) and 0.02 percent (Unit 2). The delta-large early release fraction (LERF) is 1.91E-9 /yr (Unit 1) and 1.35E-9 /yr (Unit 2) when the test interval is increased from 10 to 15 years. These delta-LERF values meet the Regulatory Guide 1.174 acceptance criterion of less than 1.0E-07 per year for LERF.

4.0 TECHNICAL ANALYSIS

The proposed change to extend the ILRT surveillance interval is justified based on a combination of risk informed analysis and assessment of the containment structural condition utilizing ILRT historical results and containment inspection programs. The risk analysis was performed consistent with the methodology contained in WCAP-15691, Rev. 4. WCAP-15691, Rev. 4 has been transmitted to the NRC separately from this LAR. A brief description and history of BVPS Units 1 and 2 Type A testing is discussed in WCAP-15691, Appendices F and G, Sections F1.2 and G1.2 respectively. Appendices F and G are included as Enclosures 2 and 3 respectively to this LAR. A more detailed description is provided in this LAR.

4.1 Risk Analysis

Enclosures 2 and 3 provide the risk-informed analysis to demonstrate that the increase in risk of extending the ILRT interval from 10 to 15 years is insignificant. The risk analysis was performed in accordance with RG 1.174 and shows that the increase in total plant risk due to the extended ILRT interval is 0.005 percent (Unit 1) and 0.02 percent (Unit 2). The delta-LERF is 1.91E-9 /yr (Unit 1) and 1.35E-9 /yr (Unit 2) when the test interval is increased from 10 to 15 years. These delta-LERF values meet the Regulatory Guide 1.174 acceptance criterion of less than 1.0E-07 per year for LERF. Additionally, Enclosures 2 and 3 also demonstrate that, from a risk perspective, an extension in the interval out to 20 years has an insignificant impact on risk. This is consistent with the findings of NUREG-1493. This LAR only requests a one-time interval extension from 10 to 15 years.

Enclosures 4 and 5 compare the BVPS Units 1 and 2 results obtained with the methodology contained in WCAP-15691, Rev. 4, to the results obtained using the Florida Power Corporation (Crystal River Unit 3) methodology.

The risk assessment contained in Enclosures 2 and 3 demonstrates:

1. The risk of extending the ILRT interval for Type A tests from its current interval of 10 years to 15 years was evaluated for public exposure impact (as measured in person-rem/yr) as described in Enclosures 2 and 3. The risk assessment predicts a slight increase in risk when compared to that estimated from current requirements. For the change from a 10 year test interval to a 15 year test interval, the increase in total risk (person-rem/year within 50 miles) was found to be 0.005 percent for Unit 1 and 0.02 percent for Unit 2. Therefore, the risk when compared with other potential severe accident contributors is considered small.

2. Regulatory Guide 1.174 provides guidance for determining the risk impact of plant specific changes to the licensing basis, and defines very small changes in the risk guidelines as increases in the core damage frequency (CDF) less than 1E-6 per reactor year and increases in LERF less than 1E-7 per reactor year. As discussed in Enclosures 2 and 3, the Type A test does not impact CDF, therefore the relevant criterion in

evaluating the proposed change is LERF. The increase in LERF resulting from a change in the Type A test frequency from the current once in 10 years to once in 15 years is estimated to be 1.91E-9 /yr (Unit 1) and 1.35E-9 /yr (Unit 2). These delta-LERF values meet the Regulatory Guide 1.174 acceptance criterion of less than 1.0E-07 per year for LERF. The cumulative increase in LERF resulting from a change in the Type A test interval from the original three in 10 years to once in 15 years is estimated to be 4.5E-9/yr (Unit 1) and 3.2E-9/yr (Unit 2). Increasing the Type A test interval to 15 years is considered to be a very small change in LERF.

3. Regulatory Guide 1.174 also encourages the use of risk analysis techniques to help ensure and show that the proposed change is consistent with the defense in depth philosophy. The only element of the multiple barrier concept that is potentially affected by this change is the measure of reliability for containment vessel integrity. The percent increase in LERF is the result of the small increase in conditional containment unreliability, which was estimated to be 0.01 percent (Unit 1) and 0.03 percent (Unit 2) in going from the current ten year interval to fifteen years. The cumulative change for going from a test interval of three times in 10 years to once in 15 years is estimated at 0.027 percent (Unit 1) and 0.072 percent (Unit 2). A more recognized term is the conditional containment failure probability (CCFP), which is discussed in Enclosures 4 and 5. The increase in CCFP was calculated to be 0.11 percent when going from the current ten year interval to a fifteen year test interval and 0.32 percent when going from three times in 10 years to once in 15 years for both BVPS units. It is concluded that the very small impact on containment failure probability demonstrates that consistency with defense-in depth philosophy is maintained for the proposed change.

4.2 Type A Containment ILRT History

Summary of BVPS Unit 1 Type A Testing History

The historical results of the Type A Tests for BVPS Unit 1 are included in the following table. The Leak Rate reported is at the 95% upper confidence level and includes any Type B and Type C Penalties.

BVPS Unit 1 Type A Testing Summary

Test Date	**Leak Rate (La)**	**Acceptance Criteria (La)**	**Test Pressure at start of test (psia)**
August 4, 1975	0.454	0.75	54.20
November 3, 1978	0.406	0.75	53.37
May 9, 1982	0.376	0.75	54.54
August 3, 1986	0.143	0.75	55.50
December 14, 1989	0.317	0.75	56.52
May 29, 1993	0.150	0.75	57.51

Six Type A full pressure containment integrated leak rate tests have been conducted at BVPS Unit 1:

1. The Pre-operational Type A Test (August 4, 1975, Total Time Leakage Rate Method),
2. The First periodic Type A Test (November 3, 1978, Total Time Leakage Rate Method),
3. The Second periodic Type A Test (May 9, 1982, Refueling Outage 2, Total Time Leakage Rate Method),
4. The Third periodic Type A Test (August 3, 1986, Refueling Outage 5, BN-TOP-1 Total Time Leakage Rate Method),
5. The Fourth periodic Type A Test (December 14, 1989, Refueling Outage 7, Mass Point Leakage Rate Method), and
6. The Fifth periodic Type A Test (May 29, 1993, Refueling Outage 9, Mass Point Leakage Rate Method).

Pre-operational Type A Test (August 4, 1975)

The pre-operational Type A Containment Integrated Leakage Rate Test was successfully completed on August 4, 1975 with a calculated Total Time Leakage Rate of 0.454 La. During the test, leakage was detected on a hand hole cover and a secondary manway cover of Steam Generator 1RC-E-1B. The containment was depressurized to repair the leakage. Following the repairs, the containment was repressurized to full test pressure and the test successfully re-performed.

First Periodic Type A Test (November 3, 1978)

The first periodic Type A Containment Integrated Leakage Rate Test was performed during the November 1978 surveillance outage. During the test, leakage from the Personnel Airlock automatic equalizing valves was identified. The valves had been locally leak tested from inside the airlock out, however during the Type A Test, pressure was being applied from outside the airlock in. The valves were manually isolated for the test and have since been removed from the airlock. Also during the test, the containment air ejector penetration was found to be leaking. The outside containment isolation valve for this penetration was found closed past its shut position (butterfly valve). The valve was reseated and the stop readjusted. The test was restarted following this adjustment, however it was evident that the resolution of the data acquisition equipment was not sufficient enough to provide consistent data. The containment building was depressurized while the data acquisition equipment was modified. During this time period, a number of activities were performed. These activities included: repair of the seats of the containment isolation valves for the containment air ejector penetration (these valves are now locally leak tested following each manipulation), local pressurization of each steam generator and repair of any leakage identified, and refilling of all penetrations that are required to be in service following a LOCA. The resolution of the test equipment was increased and a second pressure-monitoring instrument was added. The test was successfully completed with a Total Time Leakage Rate of 0.406 La measured.

Second Periodic Type A Test (May 9, 1982)

The second periodic Type A Containment Integrated Leakage Rate Test was performed during the 2nd Refueling outage. During the test, leakage was detected on one of the four Recirculation Spray Heat Exchanger (RSHX) Metal Expansion Joints (MEJ). The heat exchanger was isolated and the test successfully completed with a Total Time Leakage Rate of 0.376 La measured. Following the test, the MEJ which had been damaged during the outage was replaced and locally leak tested. The RSHX MEJ's are now locally tested in accordance with Appendix J, Option B as a Type B component.

Third Periodic Type A Test (August 3, 1986)

The third periodic Type A Containment Integrated Leakage Rate Test was performed during the 5th Refueling outage. The containment building temperature stabilization took a significant time to achieve due to fluctuating chilled water temperature to the containment air recirculation fans. The fans were secured and the test successfully completed with a BN-TOP-1 Total Time Leakage Rate of 0.143 La measured.

Fourth Periodic Type A Test (December 14, 1989)

The fourth periodic Type A Containment Integrated Leakage Rate Test was performed during the 7th Refueling outage. During the test, leakage was detected from the seal on Outside Recirculation Spray Pump 1RS-P-2B. The pump was isolated from the test boundary, however the measured leakage rate did not improve significantly. Further investigation located leakage at the fuel transfer tube penetration. The containment was depressurized to repair this leakage path. Following depressurization, it was noted that one of the two fuel transfer tube blind flange gaskets had become dislodged. Leakage had not been previously detected during the local leak test since the dislodged gasket was blocking the test connection port. With the test port blocked, the area between the two flange gaskets was not pressurized and as a result flange gasket leakage was not detected. The fuel transfer tube blind flange was reinstalled and successfully leak tested. The recirculation spray pump seal was also repaired and locally tested. The containment was repressurized and the test successfully completed with a

Mass Point Leakage Rate of 0.317 La measured. The fuel transfer tube blind flange was modified during the 8th Refueling outage by installing two test connections to allow air to be introduced into one connection and to verify that air is exiting through the second connection. The two connections allow for positive verification that the two gaskets are installed correctly and not obstructing the flow of air. The outside recirculation spray pump seals are currently locally leak tested each refueling outage.

Fifth Periodic Type A Test (May 29, 1993)

The fifth periodic Type A Containment Integrated Leakage Rate Test was performed during the 9th Refueling outage. Following completion of the leakage portion of the test, the Superimposed Leakage Test was performed. However, due to temperature stabilization problems, the superimposed leakage did not fall within the range of the acceptance criteria. The Type A Leak Test was restarted for an additional 24 hours and the Superimposed Leakage Verification Test was successfully completed with a Mass Point Leakage Rate of 0.150 La measured.

Summary of BVPS Unit 2 Type A Testing History

The historical results of the Type A Tests for BVPS Unit 2 are included in the following table. The Leak Rate reported is at the 95% upper confidence level and includes any Type B and Type C Penalties.

BVPS Unit 2 Type A Testing Summary

Test Date	**Leak Rate (La)**	**Acceptance Criteria (La)**	**Test Pressure at start of test (psia)**
February 15, 1987	0.611	0.75	61.46
November 1, 1990	0.704	0.75	61.01
November 10, 1993	0.410	0.75	61.18

Three Type A full pressure containment integrated leak rate tests have been conducted at BVPS Unit 2:

1. The Pre-operational Type A Test (February 15, 1987, Total Time Leakage Rate Method),
2. The First periodic Type A Test (November 1, 1990, Refueling Outage 2, BN-TOP-1 Total Time Leakage Rate Method), and
3. The Second periodic Type A Test (November 10, 1993, Refueling Outage 4, Mass Point Leakage Rate Method).

Pre-operational Type A Test (February 15, 1987)

The pre-operational Type A Containment Integrated Leakage Rate Test was successfully completed on February 15, 1987 with a calculated Total Time Leakage Rate of 0.611 La. During the test, leakage was detected past Demineralized Water Isolation Valve 2RSS-4 and at a compression fitting on the seal of Outside Recirculation Spray Pump 2RSS-P21B. These two leakage paths were isolated and the test successfully completed. Following completion of the Type A Leak Test, components 2RSS-4 and 2RSS-P21B were repaired and locally leak tested. These components are locally leak tested during each refueling outage.

First Periodic Type A Test (November 1, 1990)

The first periodic Type A Containment Integrated Leakage Rate Test was performed during the 2nd Refueling Outage. During the test, a high mass trend change indicated that leakage out of containment was occurring. An investigation of all potential leakage paths was performed with no significant leakage identified. The possibility of leakage into the steam generator secondary side was investigated due to an unexplained steam generator level instrumentation fluctuation. To assess this potential leakage path, the secondary sides of the 21A and 21C steam generators were pressurized with air. The change in mass trend appeared to be improving following this activity. The containment building was then depressurized to identify the exact leakage path(s). Several packing leaks and two transmitter vent connections were found to be leaking and repaired. The containment building was repressurized and after approximately eleven hours of stabilization, the temperature criteria was met. However, due to temperature stabilization problems, the superimposed leakage did not fall within the range of the acceptance criteria. The Type A Test was restarted and the Superimposed Leakage Test was successfully completed with a BN-TOP-1 Total Time Leakage Rate of 0.704 La measured.

Second Periodic Type A Test (November 10, 1993)

The second periodic Type A Containment Integrated Leakage Rate Test was performed during the 4th Refueling outage. After approximately 28 hours, the temperature stabilization criteria was met. Following temperature stabilization, the Type A Leak Test was started and successfully completed with a Mass Point Leakage Rate of 0.410 La measured.

<u>Summary of BVPS Units 1 and 2 Type A Testing History</u>

The results of the Type A, B, and C Leak Tests confirm that the BVPS Units 1 and 2 containment structures have low leakage when compared to the acceptance criteria of 0.75 La. Except for temperature stabilization delays and early instrument resolution issues, the problems identified during the previous Type A Leak Tests were all due to components, which are capable of being tested locally. The Type B and C Leak Test Program has been revised to preclude these issues during future Type A Leak Tests. Also, detailed engineering reviews of the containment penetrations have been conducted to ensure that penetration listings provided in the UFSAR and plant Licensing Requirements Manual are accurate and that testing requirements specified are properly reflected in plant surveillance procedures. These reviews further ensure a comprehensive Local Leak Rate Testing Program. In addition to the integrated and local leak rate testing program, the in-service inspection (ISI) program, the maintenance rule program, and the 40 month containment structural integrity inspection per Regulatory Guide 1.163 provide additional confidence in maintaining containment integrity.

4.3 Containment Inspections

Structural Inspection

The purpose of the containment structural inspection is to perform a visual examination of the accessible interior and exterior surfaces of the containment building for structural deterioration, which may affect either the containment structural integrity or containment leak tightness. The containment structural inspection is performed on a 40 month frequency, including prior to a Type A Leak Test. This inspection is performed in accordance with BVPS Units 1 and 2 Technical Specification Surveillance Requirement 4.6.1.6.1, ANSI/ANS-56.8-1994, "Containment Systems Leakage Testing Requirements," 1994, (Reference 10) and Regulatory Guide 1.163. The results of the most recent inspections (performed on April 5, 2000 for Unit 1 and October 17, 2000 for Unit 2) identified deficiencies that were minor in nature and did not affect the structural integrity of the containment buildings. These deficiencies have either been corrected or accepted as is. The containment structural inspections will continue to be performed on a 40-month frequency, independent of the Type A Leak Test frequency.

In-Service Inspection (ISI) Program

IWE Inspections

BVPS formalized the Primary Containment Inservice Inspection Program in December 1999. The program identifies the Class MC and Class CC items that are subject to inspection, as set forth in the 1992 Edition, including the 1992 Addenda of Section XI of the ASME Boiler and Pressure Vessel Code, within the limitations and modifications required by the Code of Federal Regulations in 10CFR50.55a. The first ASME Section XI Subsection IWE inspections of the BVPS containment liners were performed in conjunction with the containment structural inspections performed on April 5, 2000 and October 17, 2000 for Units 1 and 2 respectively. As discussed above, the deficiencies identified were minor in nature and did not affect the structural integrity of the containment buildings.

IWL Inspections

The first ASME Section XI Subsection IWL inspections of the BVPS Units 1 and 2 containment exterior concrete surfaces were performed during the summer of 2001. The surface examinations discovered some minor defects, however, all were considered non-structural in nature and have either been corrected or accepted as is.

Containment Liner Test Channel Inspections

As discussed in the description of the containments, the containment liner plate welds are covered with test channels that were used during construction to check the leak tightness of the liner plate welds. Test ports and plugs were provided to allow for leak testing of the welds. Test port plugs were found to be missing or degraded in the Units 1 and 2 containments (LERs 90-015-00 and 91-004-00) in the past. The concern associated with a missing test channel vent plug is the potential of moisture entering the channel and causing corrosion. Therefore, sampling of any accumulated water was performed for each test channel found to be compromised to evaluate the potential extent of corrosion. Based on the pH of the fluid present in the test channel, it was determined that corrosion would not present a structural integrity problem during the plant life (40 years). However, to inhibit further potential corrosion, each test channel found to be compromised was cleared of accessible debris, evacuated of air, flushed with argon gas, and plugged. This is discussed in the submittal to the NRC "Revision to SER for Amendments 165 and 47 for Beaver Valley Power Station, Unit No. 1 and No. 2," dated December 30, 1992 (Reference 11). The Units 1 and 2 containment structural inspection procedures have been revised to specifically identify all test channel vent plugs located in the containment floor to ensure that all plugs are installed.

Maintenance Rule Program

The Containment Structure and System is within the scope of the Maintenance Rule and has been classified as a risk significant system and structure. Therefore, performance criteria have been established to assure that the reliability and availability are maintained at an acceptable level. Since the inclusion of the Containment Structure in the Maintenance Rule

Program, the Containment Structure and System has remained in Paragraph (a)(2) of 10 CFR 50.65.

4.4 Responses to Five Typical NRC Containment Inspection Questions

In a similar license amendment request by Crystal River 3, the NRC staff requested a response to five questions in a letter from the NRC to Florida Power Corporation (FPC), "Crystal River Unit 3- Request for Additional Information RE: Proposed License Amendment Request No. 267, Revision 2, Containment Leakage Rate Testing Program (TAC No. MB1349)," dated July 6, 2001 (Reference 12). In subsequent submittals it has become understood that these questions should be addressed in order to more efficiently support the NRC staff review. The questions from the NRC letter and the FENOC responses are provided below.

Because the containment inservice inspection (ISI) requirements mandated by 10CFR50.55a and leak rate testing requirements of Option B of Appendix J complement each other in ensuring the leak-tightness and structural integrity of the containment, the staff needs the following information to complete its review of the license amendment request:

Question 1:

None of the references describe (or summarize) the containment ISI program being implemented at [BVPS Units 1 and 2]. Please provide a description of the ISI methods that provide assurance that in the absence of an ILRT for 15 years, the containment structural and leak tight integrity will be maintained.

Response to Question 1:

The containment Inservice Inspection program at Beaver Valley Units 1 and 2 is described in detail in the Primary Containment Inservice Inspection Program Plan, which provides the rules and requirements. The specific areas and components scheduled for inspection per sub articles IWE and IWL are provided in this plan. The program requirements include inspection of containment surfaces, pressure retaining welds, bolting, and components, seals, gaskets, and moisture barriers using visual, surface, and volumetric techniques as required. Examinations that detect flaws or evidence of degradation are documented through the site corrective action program and are dispositioned in accordance with the requirements of IWE-3000. Personnel performing the IWE/IWL containment examinations are qualified and certified in accordance with procedure QSP 2.12, "Written Practice for the Qualification and Certification of Visual Examination Personnel for Class MC and Metallic Liners of Class CC Components and Class CC Concrete Components."

Question 2:

IWE-1240 requires licensees to identify the surface areas requiring augmented examinations. Please provide the locations of the containment liner surfaces that [BVPS Units 1 and 2] have identified as requiring augmented examination and a summary of the findings of the examinations performed.

Response to Question 2:

The first period IWE general visual examinations were performed during refueling outages 1R13 and 2R08 for Beaver Valley Units 1 and 2, respectively. The program development and the subsequent examinations in 1R13 and 2R08 identified no surfaces likely to experience accelerated degradation and aging that would require augmented examinations in accordance with IWE-1240.

The NRC rulemaking set forth in 10CFR50.55a(g)(6)(ii)(B)(1) was met for both Beaver Valley Units 1 and 2. All unacceptable conditions identified during these examinations were reported and resolved in accordance with the BVPS corrective action program. Evaluation of the reported conditions concluded that the unacceptable conditions did not impact the structure or leak tight integrity of the containment buildings.

Question 3:

For the examination of seals and gaskets, and examination and testing of bolts associated with the primary containment pressure boundary (examination categories E-D and E-G), relief from the requirements of the code had been requested. As an alternative, it was proposed to examine them during the leak rate testing of the primary containment. With the flexibility provided in Option B of Appendix J for Type B and C testing (per NEI 94-

01 and Regulatory Guide 1.163), and the extension requested in this amendment for Type A testing, please provide your schedule for examination and testing of seals, gaskets, and bolts that provide assurance regarding the integrity of the containment pressure boundary.

Response to Question 3:

Relief Requests BV3-IWE1-1 and BV3-IWE1-3 have been granted from the examination requirements for seals and gaskets and examination and testing of bolts (Examination categories E-D and E-G). The alternate examination uses the 10 CFR Part 50, Appendix J, Primary Leakage Testing Program to verify the leak tight integrity of the seals, gaskets and bolted connections. Type B testing is performed on seals, gaskets and bolting each refueling outage. Plant procedures establish the maximum frequency for any individual penetration, based on acceptable performance, at once every 60 months. Additionally, prior to any maintenance that could affect containment integrity, seals and gaskets of bolted penetrations are examined by a Type B local leak rate test in order to establish an as-found condition of the penetration. Prior to re-assembly, the seals and gaskets are examined, and replaced if necessary. After the penetration is reassembled, an as-left test is performed to ensure that the penetration leakage meets the administration limits.

Bolting is examined in accordance with Table IWE-2500-1, Examination Category E-G, Pressure Retaining Bolting, Item No. E8.10.

A general visual examination of the entire containment is conducted once each inspection period in accordance with 10CFR 50.55a(b)(2)(ix)(E).

Question 4:

Stainless steel bellows have been found to be susceptible to trans-granular stress corrosion cracking, and the leakage through them are not readily detectable by Type B testing (see NRC Information Notice 92-20). If applicable, please provide information regarding inspection and testing of the bellows, and how such behavior has been factored into the risk assessment.

Response to Question 4:

There are four penetrations (1X-83, 84, 85, and 86) at BVPS Unit 1 and no penetrations at Unit 2 that contain metal expansion joint bellows. The bellows in question identified in Information Notice 92-20, "Inadequate Local Leak Rate Testing," (Reference 13) were of two-ply construction. The bellows installed at BVPS Unit 1 are of single ply construction, and are Type B Leak Tested at a maximum frequency of once every 60 months based on acceptable performance. The bellows are currently leak tested by submerging the bellows in water and pressurizing the interior to greater than Pa with air.

Question 5:

Inspections of some reinforced concrete and steel containment structures have found degradation on the uninspectable (embedded) side of the drywell steel shell and steel liner of the primary containment. These degradations cannot be found with visual (i.e., VT-1 or VT-3) examinations unless they are through the thickness of the shell or liner, or, 100% of the uninspectable surfaces are periodically examined by ultrasonic testing. Please provide information addressing how potential leakage under high pressure during core damage accidents is factored into the risk assessment related to the extension of the ILRT.

Response to Question 5:

The potential for containment leakage is explicitly included in the risk assessment. The intact containment cases (Class 1) include a leakage term that is independent of the source of the leak. The containment failure Class 3A and 3B cases model the potential leakage impact of the ILRT interval extension. These cases include the potential that the leakage may be large. Furthermore, containment leakage doses were evaluated assuming high pressure containment leakage. The assessment shows that even with the increased potential to have an undetected containment flaw or leak path, the increase in risk is insignificant.

4.5 Impact of Atmospheric Containment Conversion

The risk assessment performed to evaluate the impact of the ILRT extension to 15 years assumed that BVPS Units 1 and 2 are operated with atmospheric containments. The risk assessment is also applicable to operation of the BVPS units with sub-atmospheric containments and results in conservatively overstating the increase in the large early release frequency (LERF) as discussed below. The assumption i.e., that the BVPS units are operated as atmospheric containments, results in negligible increases (<2E-8 per year) to the plant baseline LERF and population dose. These increases to the baseline LERF and population dose are due to the assumption of pre-existing leakage associated with an atmospheric containment, which is not assumed for a sub-atmospheric containment design since pre-existing leakage would be detectable by changes in containment vacuum. While the change from sub-atmospheric to atmospheric containment operation results in a negligibly small reduction in the intact and late containment states (approximately 0.2%) the effect on the Regulatory Guide 1.174 delta LERF metric and associated radiological release ratios are insignificant. Therefore, the results of the risk assessment performed assuming operation with an atmospheric containment, are also conservatively applicable to plant operation with a sub-atmospheric containment.

4.6 Impact of PRA Model Updates

An update to the BVPS Unit 2 PRA model was completed in January, 2002. A similar update to the Unit 1 PRA model is scheduled to be completed during the first quarter of 2003. In addition, as a result of a recent Westinghouse Owners Group (WOG) PRA Peer review, some additional model changes will be made to incorporate improvements from this review.

FENOC will re-evaluate the supporting risk analysis for the ILRT surveillance interval extension using the updated PRA models for BVPS Units 1 and 2, when available, to ensure that the risk analysis continues to satisfy the criteria of RG 1.174 (Attachment B, Commitment 1).

5.0 REGULATORY SAFETY ANALYSIS

The proposed change will revise the Operating Licenses to allow extending the Type A Containment Integrated Leak Rate Test (ILRT) interval from 10 years to 15 years on a one-time basis.

5.1 No Significant Hazards Consideration

FirstEnergy Nuclear Operating Company (FENOC) has evaluated whether or not a significant hazards consideration is involved with the proposed amendments by focusing on the three standards set forth in 10CFR50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated. The proposed change allows a one-time extension to the current surveillance interval for the Type A Containment Integrated Leak Rate Test (ILRT). The current test interval of ten years, based on performance history, would be extended on a one-time basis to 15 years from the last Type A test. The proposed change will not result in a significant increase in the risk of plant operation. The risk analysis was performed in accordance with Regulatory Guide 1.174 and shows that the increase in total plant risk due to the extended ILRT interval is 0.005 percent (Unit 1) and 0.02 percent (Unit 2). The delta-large early release frequency(LERF) is 1.91E-9 /yr (Unit 1) and 1.35E-9 /yr (Unit 2) when the test interval is increased from 10 to 15 years. These delta-LERF values meet the Regulatory Guide 1.174 acceptance criterion of less than 1.0E-07 per year for LERF. The proposed extension to Type A testing does not increase the probability of an accident previously evaluated, since the containment Type A test does not involve any modifications, nor a change in the way that any plant structures, systems or components (SSC) function, and does not involve an activity that could lead to equipment failure or accident initiation. The proposed extension of the test interval does not involve a significant increase in the consequences of an accident, since the study documented in NUREG-1493, has found that generically, very few potential leak paths are not identified with Type B and C tests. NUREG-1493 concluded that an increase in the Type A test interval to twenty years resulted in an imperceptible increase in risk. Containment testing and inspection provide a high degree of assurance that the containment will not degrade in a manner only detectable by Type A testing. Inspections required by the ASME Code and the Maintenance Rule are performed in order to identify indications of containment degradation that could affect leak tightness. Type B and C testing requirements and intervals required by 10 CFR 50 Appendix J are not affected by this proposed extension to the Type A test interval, and will identify any potential openings in containment penetrations that would otherwise require a Type A test. The increase in risk of the proposed change, as measured by the change in LERF is within the acceptance criterion of Regulatory Guide 1.174, therefore there will not be a significant increase in the consequences of any accidents.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The proposed change does not result in operation of the units in a way that would create the possibility of a new or different kind of accident from any accident previously evaluated. The proposed extension to Type A testing does not create a new or different type of accident because no physical modifications are being made, and no compensatory measures are being imposed that could potentially lead to a failure. There are no changes to unit operation that could introduce a new failure mode or create a new or different kind of accident. The proposed change only allows a one-time extension to the current interval for Type A testing and does not change the implementation aspects of the subsequent test.

Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No.

The proposed change will not result in a significant reduction in a margin of safety. The proposed change is for a one-time extension to the current interval for Type A testing. The current test interval of ten years, based on historical performance, will be extended on a one-time basis to 15 years from the last Type A test. The NUREG-1493 study of the effects of extending the Type A test interval out to 20 years concluded that there is an imperceptible increase in plant risk. Additionally, the extended test interval will have a minimal affect on plant risk, since Type B and C testing detect over 95% of potential leakage paths. The plant specific risk analysis determined results that are consistent with the conclusions of NUREG-1493. The overall increase in the risk contribution due to the proposed change was determined to be 0.005 percent (Unit 1) and 0.02 percent (Unit 2). The delta-LERF is 1.91E-9 /yr (Unit 1) and 1.35E-9 /yr (Unit 2) when the test interval is increased from 10 to 15 years. The calculated impact on risk is insignificant, and meets the acceptance criterion of Regulatory Guide 1.174.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, FENOC concludes that the proposed amendments present no significant hazards consideration under the standards set forth in 10CFR50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

A review of 10CFR50 was conducted to assess the potential impact associated with the proposed changes. The following table lists the regulation and regulatory requirement potentially impacted, and an assessment of the need for a modification to the UFSAR description of BVPS design conformance to the regulation and regulatory requirement.

The paragraphs following the table provide a discussion of the modification to the Updated Final Safety Analysis Report (UFSAR) description for each regulation judged as being potentially affected. Although the UFSAR description of BVPS conformance may require a modification, in no case is an exception to the regulations required.

Regulation		**Impact**
10CFR50, Appendix A, Criterion 16	Containment Design	No
10CFR50, Appendix J	Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors	No

Regulatory Requirement		**Impact**
Regulatory Guide 1.163	Performance-Based Containment Leak-Test Program	Yes

5.2.1 Discussion of Impacts

No changes are being proposed to the containment design that would impact any of the regulations. Compliance with 10CFR50, Appendix J, Option B will be met by adding an exception to the commitment to follow the guidelines of Regulatory Guide 1.163. This exception is based on the information in NEI 94-01, and will be an extension of the currently specified 10-year interval (from the last ILRT) to a 15-year interval on a one-time basis. The evaluation performed by FENOC in Section 4.0 concludes that BVPS Units 1 and 2 will continue to comply with the above regulation and regulatory guide with the stated exception of a one-time ILRT extension to 15 years.

5.2.2 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10CFR20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10CFR51.22(c)(9). Therefore, pursuant to 10CFR51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

7.0 REFERENCES

1. Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program," September 1995.

2. NEI 94-01, "Industry Guideline for Implementing Performance Based-Option of 10 CFR50 Appendix J," July 1995.

3. Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Current Licensing Basis," July 1998.

4. WCAP-15691, Rev. 4, "Joint Applications Report for Containment Integrated Leak Rate Test Interval Extension," September 2002

5. NUREG-1493, "Performance Based Containment Leak-Test Program," September 1995.

6. FENOC letter L-02-069, dated June 5, 2002, "Beaver Valley Power Station, Unit No. 1 and No. 2, License Amendment Request Nos. 300 and 172."

7. 10CFR50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors ."

8. "Waterford Steam Electric Station, Unit 3 - Issuance of Amendment Re: Integrated Leakage Rate Testing Interval Extension (TAC No. MB2461)," dated February 14, 2002.

9. "Calvert Cliffs Nuclear Power Plant, Unit No. 1 - Amendment Re: One-Time Extension of Appendix J, Type A, Integrated Leak Rate Test Interval and Exception from Performing A Post-Modification Type A Test (TAC No. MB3929)," dated May 1, 2002.

10. ANSI/ANS-56.8-1994, "Containment Systems Leakage Testing Requirements," 1994.

11. "Revision to SER for Amendments 165 and 47 for Beaver Valley Power Station, Unit No. 1 and No. 2," dated December 30, 1992.

12. "Crystal River Unit 3- Request for Additional Information RE: Proposed License Amendment Request No. 267, Revision 2, Containment Leakage Rate Testing Program (TAC No. MB1349)," dated July 6, 2001

13. Information Notice 92-20, "Inadequate Local Leak Rate Testing."

Attachment A-1

Beaver Valley Power Station, Unit No. 1
Proposed Technical Specification Changes

License Amendment Request No. 299

The following is a list of the affected pages:

6-25

OFFSITE DOSE CALCULATION MANUAL (ODCM) (Continued)

c. Shall be submitted to the Commission in the form of a complete, legible copy of the entire ODCM as a part of or concurrent with the Annual Radioactive Effluent Release Report for the period of the report in which any change to the ODCM was made. Each change shall be identified by markings in the margin of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (e.g., month/year) the change was implemented.

6.16 Moved to the PROCESS CONTROL PROGRAM.

6.17 Containment Leakage Rate Testing Program

A program shall be established to implement the leakage rate testing of the containment as required by 10 CFR 50.54(o) and 10 CFR 50, Appendix J, Option B, as modified by approved exemptions[1]. This program shall be in accordance with the guidelines contained in Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program," dated September 1995, except that the next Type A test performed after the May 29, 1993 Type A test shall be performed no later than May 28, 2008.

The peak calculated containment internal pressure for the design basis loss of coolant accident, P_a, is 40.0 psig.

The maximum allowable containment leakage rate, L_a, at P_a, shall be 0.10% of containment air weight per day.

Leakage Rate acceptance criteria are:

a. Containment leakage rate acceptance criterion is $\leq 1.0\ L_a$ for the overall Type A leakage test and $< 0.60\ L_a$ for the Type B and Type C tests on a minimum pathway leakage rate (MNPLR) basis. During the first unit startup following testing in accordance with this program, the leakage rate acceptance criteria are $< 0.60\ L_a$ on a maximum pathway leakage rate (MXPLR)[2] basis for Type B and Type C tests and $< 0.75\ L_a$ for Type A tests.

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(1) Exemptions to Appendix J of 10 CFR 50 dated November 19, 1984, December 5, 1984, and July 26, 1995.

(2) For penetrations which are isolated by use of a closed valve(s), blind flange(s), or de-activated automatic valve(s), the MXPLR of the isolated penetration is assumed to be the measured leakage through the isolation device(s).

Attachment A-2

Beaver Valley Power Station, Unit No. 2
Proposed Technical Specification Changes

License Amendment Request No. 171

The following is a list of the affected pages:

6-25

6.14 OFFSITE DOSE CALCULATION MANUAL (ODCM)

Changes to the ODCM:

a. Shall be documented and records of reviews performed shall be retained in accordance with the applicable record retention provision of the quality assurance program description included in the Updated Final Safety Analysis Report. This documentation shall contain:

   1) Sufficient information to support the change together with the appropriate analyses or evaluations justifying the change(s) and

   2) A determination that the change will maintain the level of radioactive effluent control required by 10 CFR 20.1302, 40 CFR Part 190, 10 CFR 50.36a, and Appendix I to 10 CFR Part 50 and not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations.

b. Shall become effective after review and acceptance by the OSC and the approval of the plant manager, predesignated alternate or a predesignated manager to whom the plant manager has assigned in writing the responsibility for review and approval of specific subjects.

c. Shall be submitted to the Commission in the form of a complete, legible copy of the entire ODCM as a part of or concurrent with the Annual Radioactive Effluent Release Report for the period of the report in which any change to the ODCM was made. Each change shall be identified by markings in the margin of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (e.g., month/year) the change was implemented.

6.16 Moved to the PROCESS CONTROL PROGRAM.

6.17 CONTAINMENT LEAKAGE RATE TESTING PROGRAM

A program shall be established to implement the leakage rate testing of the containment as required by 10 CFR 50.54 (o) and 10 CFR 50, Appendix J, Option B, as modified by approved exemptions[1]. This program shall be in accordance with the guidelines contained in Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program," dated September 1995, except that the next Type A test performed after the November 10, 1993 Type A test shall be performed no later than November 9, 2008.

(1) Exemptions to Appendix J of 10 CFR 50, as stated in the operating license.

Attachment B

Beaver Valley Power Station, Unit Nos. 1 and 2

Commitment Summary

License Amendment Request Nos. 299 (Unit 1) and 171 (Unit 2)

Commitment List

The following table identifies those actions committed to by FirstEnergy Nuclear Operating Company (FENOC) for Beaver Valley Power Station (BVPS) Unit Nos. 1 and 2 in this document. Any other actions discussed in the submittal represent intended or planned actions by FENOC. They are described only as information and are not regulatory commitments. Please notify Mr. Larry R. Freeland, Manager, Regulatory Affairs/Performance Improvement, at Beaver Valley on (724) 682-5284 of any questions regarding this document or associated regulatory commitments.

COMMITMENT	REFERENCE	DUE DATE
1. FENOC will re-evaluate the supporting risk analysis for the ILRT surveillance interval extension using updated PRA models for BVPS Units 1 and 2, when available, to ensure that the risk analysis continues to satisfy the criteria of Regulatory Guide 1.174.	Enclosure 1, Section 4.6	12/31/03

ENCLOSURE 2
WCAP-15691, Revision 4
Appendix F

APPENDIX F

APPLICATION OF THE JOINT APPLICATION REPORT TO BEAVER VALLEY UNIT 1

TABLE OF CONTENTS

LIST OF TABLES

F1.0 SYSTEM DESCRIPTION AND OPERATING EXPERIENCE

F1.1 System Description

Each containment structure is a totally reinforced concrete, steel lined vessel with a flat base, cylindrical walls, and a hemispherical dome. The foundation mat is a soil bearing concrete slab approximately 10 feet thick. The inside faces of the containment wall, dome and mat are lined with steel liner plates which act as a leaktight membrane.

The cylindrical portion of the liner is 3/8 inches thick, the hemispherical dome liner is 1/2 inches thick and the floor liner covering the mat is 1/4 inches thick. The floor liner plate is covered with a thick layer of reinforced concrete that insulates it from temperature effects. All welded seams in the mat, cylindrical liner wall and hemispherical dome and liner penetrations are covered with continuously welded test channels. These channels were used to check leak tightness of the welds during liner erection. Test ports and 1/8-inch NPT pipe plugs are provided for each zone of test channels. The test port plugs remain in place during normal operation and subsequent Type A leak Rate Testing. The test channels for the cylindrical wall and penetrations are mounted inside the containment structure. The test channels for the dome area are mounted on the exterior of the dome liner. The test channels are capable of withstanding all loads that could be imposed upon them during normal and upset conditions without impairing the performance of the containment liner itself and provide additional protection in the form of a redundant barrier to the steel liner welds.

F1.2 Beaver Valley Unit 1 Operating Experience

The results of the Type A, B, and C Leak Tests confirm that the BVPS Unit 1 containment structure has low leakage when compared to the acceptance criteria of 0.75 La. Except for temperature stabilization delays and early instrument resolution issues, the problems identified during the previous Type A Leak Tests were all due to components, which are capable of being tested locally. The Type B and C Leak Test Program has been revised to preclude these issues during future Type A Leak Tests. In addition to the integrated and local leak rate testing program, the in-service inspection (ISI) program, the maintenance rule program, and the 40 month containment structural integrity inspection per Regulatory Guide 1.163 (Reference F-6) provide additional confidence in maintaining containment integrity.

F2.0 ASSESSMENT OF RISK FOR BEAVER VALLEY UNIT 1

The purpose of this section is to provide a risk informed assessment for extending the Beaver Valley Unit 1 Integrated Leak Rate Test (ILRT) interval from ten to twenty years. The risk assessment is performed as described in the main body of this report.

In addition, the results and findings from the Beaver Valley Unit 1 PRA Model (BV1 Rev. 2, June 1998) (Reference F-1) are used for this risk assessment. Specifically the approach combines the use of the Beaver Valley Unit 1 PRA Model (BV1 Rev. 2, June 1998) results and findings with the methodology described in EPRI TR-104285 to estimate public risk associated with extending the containment Type A testing.

The change in plant risk is evaluated based on the change in the predicted releases in terms of person-rem/year and Large Early Release Frequency (LERF). Changes to Type A testing have no impact on CDF.

F2.1 Overview

In October 26, 1995, the NRC revised 10 CFR 50, Appendix J. The revision to Appendix J allowed individual plants to select containment leakage testing under Option A "Prescriptive Requirements" or Option B "Performance-Based Requirements." Beaver Valley Unit 1 selected the requirements under Option B as its testing program.

The current surveillance testing requirement, as outlined in NEI 94-01 (Reference F-2) for Type A testing, is at least once per 10 years based on an acceptable performance history (define as two consecutive periodic Type A tests at least 24 months apart in which the calculated performance leakage was less than $1.0L_a$). However, Beaver Valley Unit 1 seeks to extend the test interval for Type A testing from ten years to fifteen years based on the substantial cost savings from extending this test interval and the low risk impact.

F2.2 Assessment of Risk

The risk impact of extending the ILRT (Type A) interval from its current interval of 10 years to 15 years, is evaluated from a potential public exposure impact (as measured in person-rem/year) and from a Large Early Release (LERF) perspective as identified in Regulatory Guide 1.174. The methodology used accounts for large releases and computes the LERF metric. The analysis examined the Beaver Valley Unit 1 PRA Model (BV1 Rev. 2, June 1998) for plant specific accident sequences which may impact containment performance. Specifically, as discussed in the main body of this report, core damage sequences were considered with respect to which EPRI event class they are in (EPRI TR-104285 Class 1, 2, 3, 4, 5, 6, 7 or 8 events in terms of containment integrity – Reference F-3).

Table F2-2 presents the Beaver Valley Unit 1 PSA frequencies for these eight accident classes.

F2.2.1 Quantification of Base-Line Frequency for Accident Classes

The eight EPRI accident class frequencies were determined, using the methodology described in the main body of this report, as described in the following paragraphs:

Class 1 Sequences: This group consists of all core damage accident progression bins for which the containment remains intact. Class 1 sequences arise from those core damage sequences that have long term heat removal capability available via containment sprays. The Beaver Valley Unit 1 PRA Model (BV1 Rev. 2, June 1998) estimates an overall plant CDF of 8.50E-05/year.

Based on a review of the core damage sequences, the intact containment frequency is estimated to be 7.59E-6 per year. For this analysis, it is assumed that the associated maximum containment leakage for this group is L_a (or 0.1 wt/% per day) (Reference F-4). For this analysis, the events that the PSA categorizes as intact containment events are parsed into three categories, Class 3A, Class 3B and Class 1. As discussed in the text of the main report, as Class 1 and Class 3 events are related, the frequency for Class 1 events is calculated as:

$$F_{Class\ 1} = CDF_{Intact} - F_{Class\ 3A} - F_{Class\ 3B}$$

Class 1 event frequencies are presented in the discussion of Class 3 events, below.

Class 2 Sequences: This group consists of all core damage accident progression bins for which a pre-existing leakage due to failure to isolate the containment occurs. These sequences are dominated by failure-to-close large (>2-inch diameter) containment isolation valves. Such sequences contribute to the plant LERF. Beaver Valley Unit 1 is operated as a sub-atmospheric containment and therefore the baseline PRA does not consider a pre-existing loss of containment isolation credible. In this evaluation, the containment was assumed to be atmospheric. The loss of isolation frequency was obtained by applying a loss of isolation probability to intact and late containment failure sequences. In so doing, these sequences are removed from the Classes 1 and 7 respectively and allocated to Class 2. The frequency per year for these sequences is determined in this manner to be:

$$F_{Class\ 2} = \mathbf{1.19E\text{-}08/year.}$$

Class 2 releases for Beaver Valley Unit 1 analyses are associated with pre-existing loss of isolation failures resulting in a through containment equivalent leakage from a pipe greater than 2 inches in diameter.

Class 3 Sequences: Class 3 endstates are developed specifically for this application. The Class 3 endstates include all core damage accident progression bins for which a pre-existing leakage in the containment structure exists. The containment leakage for these sequences can be grouped into two categories, small leaks or large.

The respective frequencies per year are determined as follows:

$F_{Class\ 3A} = PROB_{Class\ 3A} * CDF_{Intact}$

$F_{Class\ 3B} = PROB_{Class\ 3B} * CDF_{Intact}$

Where:

CDF_{Intact} = the Core Damage Frequency for the intact containment sequences, and is 7.59E-06/year.
$PROB_{Class\ 3A}$ = the probability of small pre-existing containment leakage in excess of design allowable.
$PROB_{Class\ 3B}$ = the probability of large pre-existing containment leakage.

$PROB_{Class\ 3A}$ and $F_{Class\ 3B}$ are a function of inspection interval and are obtained from Section 5.2.3, using Table 5-5 (reproduced here for convenience) as follows.

Probability of Type A Leakage for a Given Test Interval

Test Interval	Probability	
	Small Leak (Class 3A) ($PROB_{Class\ 3A}$)	Large Leak (Class 3B) ($PROB_{Class\ 3B}$)
3 per 10 Years	0.028	1.68E-4
10 Years	0.084	5.04E-4
15 Years	0.126	7.56E-4
20 Years	0.168	1.01E-3

The resulting values for $F_{Class\ 1}$, $F_{Class\ 3A}$, and $F_{Class\ 3B}$ as a function of ILRT interval are presented in Table F2-1.

Table F2-1
Frequency of Type A Leakage for a Given Test Interval

Test Interval	Release Class Frequency (per year)		
	$F_{Class\ 1}$	$F_{Class\ 3A}$	$F_{Class\ 3B}$
3 per 10 Years	7.38E-6	2.13E-7	1.28E-9
10 Years	6.95E-6	6.38E-7	3.83E-9
15 Years	6.63E-6	9.57E-7	5.74E-9
20 Years	6.31E-6	1.28E-6	7.65E-9

As Class 3A represents a small pre-existing containment leak, its value was set to bound the maximum quantified release identified in Table 4-2 of NUREG-1493. The largest identified release multiple was $21L_a$. Class 3A releases were therefore quantified as $25L_a$. For Beaver Valley Unit 1 this results in a containment leakage rate of 2.5 wt% per day.

Class 3B releases are assumed to be greater than $100L_a$ (or 10 wt% per day). Releases in this category were represented by a 100 wt% per day release which is roughly equivalent to a release from a 2.5 inch orifice. This leakage is essentially equivalent to $1000L_a$ (for Beaver Valley Unit 1) and is considered a very conservative estimate of potential containment releases that may result from extension of Type A containment Testing. The specific man-rem estimate for this release was evaluated by multiplying the intact release calculated dose by 1000.

<u>Class 4 Sequences:</u> This group consists of all core damage accident progression bins for which a failure-to-seal containment isolation failure of Type B test components occurs. Because these failures are detected by Type B tests, this group is not evaluated any further.

<u>Class 5 Sequences:</u> This group consists of all core damage accident progression bins for which a failure-to-seal containment isolation failure of Type C test components occurs. Because these failures are detected by Type C tests, this group is not evaluated any further.

<u>Class 6 Sequences:</u> This group is similar to Class 2. These are sequences that involve core damage accident progression bins for which a failure-to-seal containment leakage due to failure to isolate the containment occurs. These sequences are dominated by failure of isolation valves to close following an event. This value was taken directly from the Beaver Valley Unit 1 PRA.

$$\mathbf{F_{Class\,6} = 1.11E\text{-}05\ /\ year}$$

<u>Class 7 Sequences:</u> This group consists of all core damage accident progression bins in which containment failure induced by severe accident phenomena occurs (e.g., H_2 combustion).

$$F_{Class\,7} = CDF_{CFL} + CDF_{CFE}$$

Where:
CDF_{CFE} = the CDF resulting from phenomena that lead to early containment failure.
CDF_{CFL} = the CDF resulting from phenomena that lead to late containment failure.

This frequency was determined by subtracting the intact, bypass (See Class 8 discussion) and loss of isolation CDFs from the total CDF. This results in the following Class 7 frequency:

$$\mathbf{F_{Class\,7} = 5.98E\text{-}5\ /\ year}$$

These endstates include containment failure. It was determined from the PRA that the early component of $F_{Class\,7}$, CDF_{CFE}, is 5.94E-07. The small contribution of early containment failures for Beaver Valley Unit 1 is a result of the robust containment design.

<u>Class 8 Sequences:</u> This group consists of all core damage accident progression bins in which containment bypass occurs.

Using the results of the most recent Beaver Valley Unit 1 PSA and including ISLOCA and SGTR sequences, the failure frequency for this class is 6.54E-6 / year.

$$F_{Class\ 8} = 6.54E\text{-}6\ /\ year$$

Table F2-2 provides a summary of the Beaver Valley Unit 1 Release Class frequencies.

Table F2-2
Beaver Valley Unit 1 Mean Containment Frequencies (from the PSA)

Class	Description	Frequency (per Rx-year)
1	No Containment Failure	7.38E-06
2	Large Containment Isolation Failures (failure-to-close)	1.19E-08
3A	Small Pre-existing Containment Leak	2.13E-07
3B	Large Pre-existing Containment Leak	1.28E-09
4	Small isolation failure - failure-to-seal (Type B test)	Not Analyzed
5	Small isolation failure - failure-to-seal (Type C test)	Not Analyzed
6	Containment Isolation Failures (dependent failures, personnel errors)	1.11E-05
7	Severe Accident Phenomena Induced Failure (early and late failures)	5.98E-05
8	Containment Bypassed (SGTR / ISLOCA)	6.54E-06
Total	All CET Endstates	8.50E-05

F2.2.2 Beaver Valley Unit 1 population dose per reactor year

Plant-specific release analysis was performed for Beaver Valley Unit 1 to evaluate the doses to the population, within a 50-mile radius from the plant. The releases for Classes 1 through 7 are based on post large Loss-Of-Coolant Accident (LOCA) as shown in Table F2-3 and the releases for Class 8 events are based on Bypass events as shown in Table F2-4. These tables tabulate the whole body population dose within 50 miles. Calculations were performed using RADTRAD Version 3.03 (Reference F-5) assuming containment source term equivalent to ICRP30. Intact containment release computations were validated via comparisons with Beaver Valley UFSAR results.

In performing the above analyses offsite population estimates are based on Beaver Valley Unit 1 demographics projections to 2030. Atmospheric dispersions are based on values reported in the plant UFSAR.

Table F2-3
Beaver Valley Unit 1 Population Dose – Intact Containment

Beaver Valley Doses and Population Doses due to LOCA			
		Doses (rem)	Doses (person-rem)
Zone (miles)	Population	Containment Leakage Events (based on leakage of 1 L_a)	Containment Leakage Events (based on leakage of 1 L_a)
0-1	609	4.29E+00	2.61E+03
1-2	3318	2.70E+00	8.97E+03
2-5	13924	7.06E-01	9.83E+03
5-10	137381	2.07E-01	2.84E+04
10-15	178042	8.95E-02	1.59E+04
15-20	217474	5.04E-02	1.10E+04
20-30	1599543	3.29E-02	5.26E+04
30-40	1591635	1.89E-02	3.00E+04
40-50	889472	1.36E-02	1.21E+04
Total	4631398		1.71E+05

Table F2-4
Beaver Valley Unit 1 Population Dose – Bypass Events

Beaver Valley Doses and Population Doses due to Bypass Events			
		Doses (rem)	Doses (person-rem)
Zone (miles)	Population	Containment Leakage Events (based on leakage of 1 L_a)	Containment Leakage Events (based on leakage of 1 L_a)
0-1	609	1.12E+04	6.83E+06
1-2	3318	7.08E+03	2.35E+07
2-5	13924	1.85E+03	2.58E+07
5-10	137381	5.43E+02	7.46E+07
10-15	178042	2.34E+02	4.17E+07
15-20	217474	1.32E+02	2.87E+07
20-30	1599543	8.63E+01	1.38E+08
30-40	1591635	4.95E+01	7.88E+07
40-50	889472	3.57E+01	3.17E+07
Total	4631398		4.50E+08

The population dose, out to 50 miles is determined based on the design-basis normal containment leak rate of 0.1% /day, and is 1.71E+05 person-rem per event. Since the containment release pathways are generally the same for containment Classes 1 through 7, the population doses are directly proportional to the ratio of the leakage rate to that of the intact nominal leakage case (Class 1). Therefore, the Class 2 through 7 leakage related doses are ratioed upwards to account for the increased leakages associated with event Classes 2 through 7. Classes 1 through 8 leakages and doses are summarized in Table F2-5.

Table F2-5
Beaver Valley Unit 1 Containment Leakage Rate and Dose – for Accident Classes

Class	Description	Leakage (wt%/day)	Release (50 miles) (person-rem)	Basis
1	No Containment Failure	0.1 (L_a)	1.71E+05	See Table F2-3
2	Large Containment Isolation Failures (failure-to-close)	100	1.71E+08	Ratio from class 1 baseline
3A	Small Isolation Failures (containment leak)	2.5 (25 L_a)	4.28E+06	Ratio from class 1 baseline
3B	Large Isolation Failures (containment leak)	100	1.71E+08	Ratio from class 1 baseline
4	Small isolation failure - failure-to-seal (Type B test)	Not Analyzed	Not Analyzed	Not Analyzed
5	Small isolation failure - failure-to-seal (Type C test)	Not Analyzed	Not Analyzed	Not Analyzed
6	Containment Isolation Failures (dependent failures, personnel errors)	35	5.99E+07	Ratio from class 1 baseline
7	Severe Accident Phenomena Induced Failure (early and late failures)	280	4.79E+08	Ratio from class 1 baseline
8	Containment Bypassed (SGTR / ISLOCA)	-	4.50E+08	No credit for containment

The above results when combined with the frequencies presented in Table F2-2 yield the Beaver Valley Unit 1 baseline mean consequence measures (risks, in terms of person-rem/yr) for each accident class. The resulting risks (in terms of person-rem/yr), for each accident class, are presented in Table F2-6 below.

Table F2-6
Beaver Valley Unit 1 Mean Baseline Risk - for Accident Classes

Class	Description	Frequency (per Rx-yr)	Person-Rem (50-Miles)	Person-Rem/yr (50-Miles)
1	No Containment Failure	7.38E-06	1.71E+05	1.26E+00
2	Large Isolation Failures (failure to close)	1.19E-08	1.71E+08	2.03E+00
3A	Small Pre-existing Containment Leak	2.13E-07	4.28E+06	9.09E-01
3B	Large Pre-existing Containment Leak	1.28E-09	1.71E+08	2.18E-01
4	Small Isolation Failure to Seal (Type B Test)	Not Analyzed	Not Analyzed	Not Analyzed
5	Small Isolation Failure to Seal (Type C Test)	Not Analyzed	Not Analyzed	Not Analyzed
6	Other Isolation Failures (e.g., dependent failures)	1.11E-05	5.99E+07	6.64E+02
7	Failure Induced by Phenomena (early and late failures)	5.98E-05	4.79E+08	2.86E+04
8	Bypass (SGTR / ISLOCA)	6.54E-06	4.50E+08	2.94E+03
Total	All CET End States	8.50E-05	N/A	32244.00

N/A is Not Applicable

Based on the above values, the percent risk contribution associated with the "intact" containment sequences for Class 1 and Class 3 ($\%Risk_{BASE}$) is as follows:

$$\%Risk_{BASE} = [(Risk_{Class\ 1\ BASE} + Risk_{Class\ 3A\ BASE} + Risk_{Class\ 3B\ BASE}) / Total_{BASE}] \times 100$$

Where:

$Risk_{Class\ 1\ BASE}$ = Class 1 person-rem/yr = 1.26E+00 person-rem/yr [Table F2-6]

$Risk_{Class\ 3A\ BASE}$ = Class 3A person-rem/yr = 9.09E-01 person-rem/yr [Table F2-6]

$Risk_{Class\ 3B\ BASE}$ = Class 3B person-rem/yr = 2.18E-01 person-rem/yr [Table F2-6]

$Total_{BASE}$ = total dose/year for baseline interval = 32244.00 person-rem/year [Table F2-6]

$\%Risk_{BASE}$ = [(1.26E+00 + 9.09E-01 + 2.18E-01) / 32244.00] x 100

$\%Risk_{BASE}$ = 0.007 %

Therefore, the total baseline risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.007 %.

F2.2.3 Risk Impact of Extending Type A Test Interval From 10 To 15 And 20 Years

Using the methodology described in the main report that was used above to determine baseline risk values (see Table F2-6), the risk values were determined for the Current 10 year ILRT test interval, a 15 year ILRT test interval, and a 20 year ILRT test interval. These risk values are presented below in Table F2-7.

Table F2-7
Beaver Valley Unit 1 Risk Values vs ILRT Interval (Person-Rem/yr to 50-Miles)

Class	Description	Current 10 year ILRT interval	15 year ILRT interval	20 year ILRT interval
1	No Containment Failure	1.19E+00	1.13E+00	1.08E+00
2	Large Isolation Failures (failure to close)	2.03E+00	2.03E+00	2.03E+00
3A	Small Pre-existing Containment Leak	2.73E+00	4.09E+00	5.45E+00
3B	Large Pre-existing Containment Leak	6.54E-01	9.82E-01	1.31E+00
4	Small Isolation Failure to Seal (Type B Test)	Not Analyzed	Not Analyzed	Not Analyzed
5	Small Isolation Failure to Seal (Type C Test)	Not Analyzed	Not Analyzed	Not Analyzed
6	Other Isolation Failures (e.g., dependent failures)	6.64E+02	6.64E+02	6.64E+02
7	Failure Induced by Phenomena (early and late failures)	2.86E+04	2.86E+04	2.86E+04
8	Bypass (SGTR/ISLOCA)	2.94E+03	2.94E+03	2.94E+03
Total	All CET End States	32246.18	32247.82	32249.45

Based on the above values, and using the methodology described in the main report, the percent risk contribution ($\%Risk_N$, for values of N of 10, 15 and 20 years) for Class 1 and Class 3 is determined and yields the results summarized in Table F2-8, below. Also, the percent change in risk due to ILRT interval extensions is determined and presented in Table F2-8.

Table F2-8
Beaver Valley Unit 1 Percent Risk Increases from ILRT Interval Extensions

	Description	Current 10 year ILRT interval	15 year ILRT interval	20 year ILRT interval
$\%Risk_N$	Percent risk contribution for Class 1 and Class 3	0.014%	0.019%	0.024%
$\Delta\%Risk_{Base\ to\ N}$	Percent increase in total risk due to an N-year ILRT over the baseline case	0.007%	N/A	N/A
$\Delta\%Risk_{10\text{-}N}$	Percent increase in risk due to an N-year ILRT over the 10 year case	N/A	0.005%	0.010%

F2.2.4 Change In Risk In Terms Of Large Early Release Frequency (LERF)

Section 5.2.4 of the main body of this report discusses the quantification of LERF. This analysis assumes that Class 2, 3B, 6, 7 and 8 lead to large leak rates. The baseline LERF frequency, for the 3 in 10 year inspection interval, is determined as shown in Table F2-9. The estimate for Class 7 includes only the portion of Class 7 identified in the PSA as representing early containment failure.

Table F2-9
Beaver Valley Unit 1 Baseline LERF Frequency Calculation

Class	Description	LERF
2	Large Isolation Failures (failure to close)	1.19E-08
3B	Large Pre-existing Containment Leak	1.28E-09
6	Other Isolation Failures (e.g., dependent failures)	1.11E-05
7 (Early)	Failure Induced by Phenomena (early failures)	5.94E-07
8	Bypass (SGTR / ISLOCA)	6.54E-06
LERF	(total)	**1.825E-05**

Impact of ILRT Test Interval Extensions on Large Early Release Frequency (LERF)

Table F2-10 presents the frequencies for each large release class, for each of four ILRT intervals. The total LERFs are also listed, along with the increase in LERF from the current LERF, and the percent increase from the current LERF.

As the only class contributor to the change in large early release is due to Class 3B events, the $\Delta LERF = F_{Class\ 3B}$ (evaluated at the new inspection interval) – $F_{Class\ 3B}$ (of the baseline interval or the current interval, as appropriate).

The percent change in LERF is calculated as:

$\%\Delta LERF = [\Delta LERF/LERF_{Total}] \times 100$

Where:
$LERF_{Total}$ = The sum of the Frequencies of Sequences 2, 3B, 6, 8, and the "early" portion of Class 7, (5.94E-07).

Table F2-10
Beaver Valley Unit 1 LERF Variation as a Function of Change in Inspection Interval

Class	Description	3 per 10 Years	10 Years	15 Years	20 Years
2	Large Isolation Failures (failure to close)	1.19E-08	1.19E-08	1.19E-08	1.19E-08
3B	Large Pre-existing Containment Leak	1.28E-09	3.83E-09	5.74E-09	7.65E-09
6	Other Isolation Failures (e.g., dependent failures)	1.11E-05	1.11E-05	1.11E-05	1.11E-05
7 (Early)	Failure Induced by Phenomena (early failures)	5.94E-07	5.94E-07	5.94E-07	5.94E-07
8	Bypass (SGTR)	6.54E-06	6.54E-06	6.54E-06	6.54E-06
LERF	Total	1.8247E-05	1.8250E-05	1.8252E-05	1.8254E-05
ΔLERF	Increase from Current LERF	N/A	0.0	1.914E-09	3.827E-09
%ΔLERF	% Increase from Current LERF	N/A	0.0%	0.01%	0.02%

F3.0 SUMMARY OF RESULTS

Baseline ILRT Interval Results (For this evaluation, the baseline risk contribution is taken as the original inspection interval at the time that the Beaver Valley Unit 1 PRA Model (BV1 Rev. 2, June 1998) was done; that is, three inspections per 10 year interval)

1. The baseline risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.007 % of total risk.

2. The baseline LERF is 1.8247E-05 per year.

Ten Year ILRT Interval Results

1. The current Type A 10-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.014 % of total risk.

2. The increase in total risk from extending the ILRT test interval from the baseline interval to current 10 year interval is 0.007 %.

3. The LERF with a 10 year ILRT interval is 1.8250E-05 per year.

4. The increase in LERF from extending the ILRT test interval from the baseline interval to the current 10 year interval is 2.551E-09 per year.

5. The % increase in LERF from extending the ILRT test interval from the baseline interval to 10 years is 0.01%. Since the CDF is not changed as a result of the extended ILRT interval, the increase in LERF is due only to the small increase (0.01 %) in conditional containment unreliability.

Fifteen Year ILRT Interval Results

1. Type A 15-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.019 % of total risk.

2. The increase in total risk from extending the ILRT test interval from the current 10 year interval to 15 years is 0.005 %.

3. The LERF for the 15 year interval is 1.8252E-05 per year.

4. The increase in LERF from extending the ILRT test interval from the 10 year interval to 15 years is 1.914E-09 per year.

5. The % increase in LERF from extending the ILRT test interval from the 10 year interval to 15 years is 0.01%. Since the CDF is not changed as a result of the extended ILRT

interval, the increase in LERF is due only to the small increase (0.01 %) in conditional containment unreliability.

Twenty Year ILRT Interval Results

1. Type A 20-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios 0.024 % of total risk.

2. The increase in total risk from extending the ILRT test interval from the current 10 year interval to 20 years is 0.010 %.

3. The LERF for the 20 year interval is 1.8254E-05 per year.

4. The increase in LERF from extending the ILRT test interval from the 10 year interval to 20 years is 3.827E-09 per year.

5. The % increase in LERF from extending the ILRT test interval from the 10 year interval to 20 years is 0.02%. Since the CDF is not changed as a result of the extended ILRT interval, the increase in LERF is due only to the small increase (0.02 %) in conditional containment unreliability.

F4.0 REFERENCES

F-1 Beaver Valley Unit 1 PRA Model (BV1 Rev. 2, June 1998).

F-2 NEI 94-01, Revision 0 "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50," Appendix J, July 26, 1995.

F-3 EPRI TR-104285, "Risk Assessment of Revised Containment Leak Rate Testing Intervals," August 1994.

F-4 Beaver Valley Unit 1 UFSAR, Rev. 20.

F-5 NUREG/CR-6604, Supplement 1, RADTRAD: A Simplified Model for RADionuclide Transport And Dose estimation, SNL, Bixler, N.E. et al, June 1999.

F-6 Regulatory Guide 1.163.

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Appendix G

APPENDIX G

APPLICATION OF THE JOINT APPLICATION REPORT TO BEAVER VALLEY UNIT 2

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G1.0 SYSTEM DESCRIPTION AND OPERATING EXPERIENCE

G1.1 System Description

Each containment structure is a totally reinforced concrete, steel lined vessel with a flat base, cylindrical walls, and a hemispherical dome. The foundation mat is a soil bearing concrete slab approximately 10 feet thick. The inside faces of the containment wall, dome and mat are lined with steel liner plates which act as a leaktight membrane.

The cylindrical portion of the liner is 3/8 inches thick, the hemispherical dome liner is 1/2 inches thick and the floor liner covering the mat is 1/4 inches thick. The floor liner plate is covered with a thick layer of reinforced concrete that insulates it from temperature effects. All welded seams in the mat, cylindrical liner wall and hemispherical dome and liner penetrations are covered with continuously welded test channels. These channels were used to check leak tightness of the welds during liner erection. Test ports and 1/8-inch NPT pipe plugs are provided for each zone of test channels. The test port plugs remain in place during normal operation and subsequent Type A leak Rate Testing. The test channels for the cylindrical wall and penetrations are mounted inside the containment structure. The test channels for the dome area are mounted on the exterior of the dome liner. The test channels are capable of withstanding all loads that could be imposed upon them during normal and upset conditions without impairing the performance of the containment liner itself and provide additional protection in the form of a redundant barrier to the steel liner welds.

G1.2 Beaver Valley Unit 2 Operating Experience

The results of the Type A, B, and C Leak Tests confirm that the BVPS Unit 2 containment structure has low leakage when compared to the acceptance criteria of 0.75 La. Except for temperature stabilization delays, the problems identified during the previous Type A Leak Tests were all due to components, which are capable of being tested locally. The Type B and C Leak Test Program has been revised to preclude these issues during future Type A Leak Tests. In addition to the integrated and local leak rate testing program, the in-service inspection (ISI) program, the maintenance rule program, and the 40 month containment structural integrity inspection per Regulatory Guide 1.163 (Reference G-6) provide additional confidence in maintaining containment integrity.

G2.0 ASSESSMENT OF RISK FOR BEAVER VALLEY UNIT 2

The purpose of this section is to provide a risk informed assessment for extending the Beaver Valley Unit 2 Integrated Leak Rate Test (ILRT) interval from ten to twenty years. The risk assessment is performed as described in the main body of this report.

In addition, the results and findings from the Beaver Valley Unit 2 PRA Model (BV2 Rev. 3A, January 2002) (Reference G-1) are used for this risk assessment. Specifically the approach combines the use of the Beaver Valley Unit 2 PRA Model (BV2 Rev. 3A, January 2002) results and findings with the methodology described in EPRI TR-104285 to estimate public risk associated with extending the containment Type A testing.

The change in plant risk is evaluated based on the change in the predicted releases in terms of person-rem/year and Large Early Release Frequency (LERF). Changes to Type A testing have no impact on CDF.

G2.1 Overview

In October 26, 1995, the NRC revised 10 CFR 50, Appendix J. The revision to Appendix J allowed individual plants to select containment leakage testing under Option A "Prescriptive Requirements" or Option B "Performance-Based Requirements." Beaver Valley Unit 2 selected the requirements under Option B as its testing program.

The current surveillance testing requirement, as outlined in NEI 94-01 (Reference G-2) for Type A testing, is at least once per 10 years based on an acceptable performance history (define as two consecutive periodic Type A tests at least 24 months apart in which the calculated performance leakage was less than $1.0L_a$). However, Beaver Valley Unit 2 seeks to extend the test interval for Type A testing from ten years to fifteen years based on the substantial cost savings from extending this test interval and the low risk impact.

G2.2 Assessment of Risk

The risk impact of extending the ILRT (Type A) interval from its current interval of 10 years to 15 years, is evaluated from a potential public exposure impact (as measured in person-rem/year) and from a Large Early Release (LERF) perspective as identified in Regulatory Guide 1.174. The methodology used accounts for large releases and computes the LERF metric. The analysis examined the Beaver Valley Unit 2 PRA Model (BV2 Rev. 3A, January 2002) for plant specific accident sequences which may impact containment performance. Specifically, as discussed in the main body of this report, core damage sequences were considered with respect to which EPRI event class they are in (EPRI TR-104285 Class 1, 2, 3, 4, 5, 6, 7 or 8 events in terms of containment integrity – Reference G-3).

Table G2-2 presents the Beaver Valley Unit 2 PSA frequencies for these eight accident classes.

G2.2.1 Quantification of Base-Line Frequency for Accident Classes

The eight EPRI accident class frequencies were determined, using the methodology described in the main body of this report, as described in the following paragraphs:

Class 1 Sequences: This group consists of all core damage accident progression bins for which the containment remains intact. Class 1 sequences arise from those core damage sequences that have long term heat removal capability available via containment sprays. PSA upgrades performed over the past several years have resulted in an overall plant CDF estimate of 1.64E-05/year.

Based on a review of the core damage sequences, the intact containment frequency is estimated to be 5.37E-06 per year. For this analysis, it is assumed that the associated maximum containment leakage for this group is L_a (or 0.1 wt/% per day) (Reference G-4). For this analysis, the events that the Beaver Valley Unit 2 PRA Model (BV2 Rev. 3A, January 2002) categorizes as intact containment events are parsed into three categories, Class 3A, Class 3B and Class 1. As discussed in the text of the main report, as Class 1 and Class 3 events are related, the frequency for Class 1 events is calculated as:

$$F_{Class\ 1} = CDF_{Intact} - F_{Class\ 3A} - F_{Class\ 3B}$$

Class 1 event frequencies are presented in the discussion of Class 3 events, below.

Class 2 Sequences: This group consists of all core damage accident progression bins for which a pre-existing leakage due to failure to isolate the containment occurs. These sequences are dominated by failure-to-close large (>2-inch diameter) containment isolation valves. Such sequences contribute to the plant LERF. Beaver Valley Unit 2 is operated as a sub-atmospheric containment and therefore the baseline PRA does not consider a pre-existing loss of containment isolation credible. In this evaluation, the containment was assumed to be atmospheric. The loss of isolation frequency was obtained by applying a loss of isolation probability to intact and late containment failure sequences. In so doing, these sequences are removed from the Classes 1 and 7 respectively and allocated to Class 2. The frequency per year for these sequences is determined in this manner to be;

$$F_{Class\ 2} = \mathbf{2.16E\text{-}09\ /year}$$

Class 2 releases for Beaver Valley Unit 2 analyses are associated with pre-existing loss of isolation failures resulting in a through containment equivalent leakage from a pipe greater than 2 inches in diameter.

Class 3 Sequences: Class 3 endstates are developed specifically for this application. The Class 3 endstates include all core damage accident progression bins for which a pre-existing leakage in the containment structure exists. The containment leakage for these sequences can be grouped into two categories, small leaks or large.

The respective frequencies per year are determined as follows:

$F_{Class\ 3A} = PROB_{Class\ 3A} * CDF_{Intact}$

$F_{Class\ 3B} = PROB_{Class\ 3B} * CDF_{Intact}$

Where:

CDF_{Intact} = the Core Damage Frequency for the intact containment sequences, and 5.37E-06/year.
$PROB_{Class\ 3A}$ = the probability of small pre-existing containment leakage in excess of design allowable.
$PROB_{Class\ 3B}$ = the probability of large pre-existing containment leakage.

$PROB_{Class\ 3A}$ and $F_{Class\ 3B}$ are a function of inspection interval and are obtained from Section 5.2.3, using Table 5-5 (reproduced here for convenience) as follows.

Probability of Type A Leakage for a Given Test Interval

Test Interval	Probability	
	Small Leak (Class 3A) ($PROB_{Class\ 3A}$)	Large Leak (Class 3B) ($PROB_{Class\ 3B}$)
3 per 10 Years	0.028	1.68E-4
10 Years	0.084	5.04E-4
15 Years	0.126	7.56E-4
20 Years	0.168	1.01E-3

The resulting values for $F_{Class\ 1}$, $F_{Class\ 3A}$, and $F_{Class\ 3B}$ as a function of ILRT interval are presented in Table G2-1.

Table G2-1
Frequency of Type A Leakage for a Given Test Interval

Test Interval	Release Class Frequency (per year)		
	$F_{Class\ 1}$	$F_{Class\ 3A}$	$F_{Class\ 3B}$
3 per 10 Years	5.22E-06	1.50E-07	9.02E-10
10 Years	4.92E-06	4.51E-07	2.71E-09
15 Years	4.69E-06	6.77E-07	4.06E-09
20 Years	4.46E-06	9.02E-07	5.41E-09

As Class 3A represents a small pre-existing containment leak, its value was set to bound the maximum quantified release identified in Table 4-2 of NUREG-1493. The largest identified release multiple was $21L_a$. Class 3A releases were therefore quantified as $25L_a$. For Beaver Valley Unit 2 this results in a containment leakage rate of 2.5 wt% per day.

Class 3B releases are assumed to be greater than $100L_a$ (or 10 wt% per day). Releases in this category were represented by a 100 wt% per day release which is roughly equivalent to a release from a 2.5 inch orifice. This leakage is essentially equivalent to $1000L_a$ (for Beaver Valley Unit 2) and is considered a very conservative estimate of potential containment releases that may result from extension of Type A containment Testing. The specific man-rem estimate for this release was evaluated by multiplying the intact release calculated dose by 1000.

Class 4 Sequences: This group consists of all core damage accident progression bins for which a failure-to-seal containment isolation failure of Type B test components occurs. Because these failures are detected by Type B tests, this group is not evaluated any further.

Class 5 Sequences: This group consists of all core damage accident progression bins for which a failure-to-seal containment isolation failure of Type C test components occurs. Because these failures are detected by Type C tests, this group is not evaluated any further.

Class 6 Sequences: This group is similar to Class 2. These are sequences that involve core damage accident progression bins for which a failure-to-seal containment leakage due to failure to isolate the containment occurs. These sequences are dominated by failure of isolation valves to close following an event. This value was taken directly from the Beaver Valley Unit 2 PRA.

$$\mathbf{F_{Class\ 6} = 5.43E\text{-}08/\ year}$$

Class 7 Sequences: This group consists of all core damage accident progression bins in which containment failure induced by severe accident phenomena occurs (e.g., H_2 combustion).

$$F_{Class\ 7} = CDF_{CFL} + CDF_{CFE}$$

Where:
CDF_{CFE} = the CDF resulting from phenomena that lead to early containment failure.
CDF_{CFL} = the CDF resulting from phenomena that lead to late containment failure.

This frequency was determined by subtracting the intact, bypass (See Class 8 discussion) and loss of isolation CDFs from the total CDF. This results in the following Class 7 frequency:

$$\mathbf{F_{Class\ 7} = 7.27E\text{-}06\ /\ year}$$

These endstates include containment failure. It was determined from the PRA that the early component of $F_{Class\ 7}$, CDF_{CFE}, is 5.06E-07. The small contribution of early containment failures for Beaver Valley Unit 2 is a result of the robust containment design.

Class 8 Sequences: This group consists of all core damage accident progression bins in which containment bypass occurs.

Using the results of the most recent Beaver Valley Unit 2 PSA and including ISLOCA and SGTR sequences, the failure frequency for this class is 3.75E-06/ year.

$$F_{Class\ 8} = 3.75E\text{-}06 \ / \ year$$

Table G2-2 provides a summary of the Beaver Valley Unit 2 Release Class frequencies.

Table G2-2
Beaver Valley Unit 2 Mean Containment Frequencies (from the PSA)

Class	Description	Frequency (per Rx-year)
1	No Containment Failure	5.22E-06
2	Large Containment Isolation Failures (failure-to-close)	2.16E-09
3A	Small Pre-existing Containment Leak	1.50E-07
3B	Large Pre-existing Containment Leak	9.02E-10
4	Small isolation failure - failure-to-seal (Type B test)	Not Analyzed
5	Small isolation failure - failure-to-seal (Type C test)	Not Analyzed
6	Containment Isolation Failures (dependent failures, personnel errors)	5.43E-08
7	Severe Accident Phenomena Induced Failure (early and late failures)	7.27E-06
8	Containment Bypassed (SGTR / ISLOCA)	3.75E-06
Total	All CET Endstates	1.64E-05

G2.2.2 Beaver Valley Unit 2 population dose per reactor year

Plant-specific release analysis was performed for Beaver Valley Unit 2 to evaluate the doses to the population, within a 50-mile radius from the plant. The releases for Classes 1 through 7 are based on post large Loss-Of-Coolant Accident (LOCA) as shown in Table G2-3 and the releases for Class 8 events are based on Bypass events as shown in Table G2-4. These tables tabulate the whole body population dose within 50 miles. Calculations were performed using RADTRAD Version 3.03 (Ref. G-5) assuming containment source term equivalent to ICRP30. Intact containment release computations were validated via comparisons with Beaver Valley UFSAR results.

In performing the above analyses offsite population estimates are based on Beaver Valley Unit 2 demographics projections to 2030. Atmospheric dispersions are based on values reported in the plant UFSAR.

Table G2-3
Beaver Valley Unit 2 Population Dose – Intact Containment

Beaver Valley Doses and Population Doses due to LOCA			
		Doses (rem)	Doses (person-rem)
Zone (miles)	Population	Containment Leakage Events (based on leakage of 1 L_a)	Containment Leakage Events (based on leakage of 1 L_a)
0-1	609	4.28E+00	2.61E+03
1-2	3318	2.70E+00	8.96E+03
2-5	13924	7.05E-01	9.82E+03
5-10	137381	2.07E-01	2.84E+04
10-15	178042	8.93E-02	1.59E+04
15-20	217474	5.03E-02	1.09E+04
20-30	1599543	3.29E-02	5.26E+04
30-40	1591635	1.88E-02	3.00E+04
40-50	889472	1.36E-02	1.21E+04
Total	4631398		1.71E+05

Table G2-4
Beaver Valley Unit 2 Population Dose – Bypass Events

Beaver Valley Doses and Population Doses due to Bypass Events			
		Doses (rem)	Doses (person-rem)
Zone (miles)	Population	Containment Leakage Events (based on leakage of 1 L_a)	Containment Leakage Events (based on leakage of 1 L_a)
0-1	609	1.12E+04	6.83E+06
1-2	3318	7.08E+03	2.35E+07
2-5	13924	1.85E+03	2.58E+07
5-10	137381	5.43E+02	7.46E+07
10-15	178042	2.34E+02	4.17E+07
15-20	217474	1.32E+02	2.87E+07
20-30	1599543	8.63E+01	1.38E+08
30-40	1591635	4.95E+01	7.88E+07
40-50	889472	3.57E+01	3.17E+07
Total	4631398		4.50E+08

The population dose, out to 50 miles is determined based on the design-basis normal containment leak rate of 0.1% /day, and is 1.71E+05 person-rem per event. Since the containment release pathways are generally the same for containment Classes 1 through 7, the population doses are directly proportional to the ratio of the leakage rate to that of the intact nominal leakage case (Class 1). Therefore, the Class 2 through 7 leakage related doses are ratioed upwards to account for the increased leakages associated with event Classes 2 through 7. Classes 1 through 8 leakages and doses are summarized in Table G2-5.

Table G2-5
Beaver Valley Unit 2 Containment Leakage Rate and Dose – for Accident Classes

Class	Description	Leakage (wt%/day)	Release (50 miles) (person-rem)	Basis
1	No Containment Failure	0.1 (L_a)	1.71E+05	See Table G2-3
2	Large Containment Isolation Failures (failure-to-close)	100	1.71E+08	Ratio from class 1 baseline
3A	Small Isolation Failures (containment leak)	2.5 (25 L_a)	4.28E+06	Ratio from class 1 baseline
3B	Large Isolation Failures (containment leak)	100	1.71E+08	Ratio from class 1 baseline
4	Small isolation failure - failure-to-seal (Type B test)	Not Analyzed	Not Analyzed	Not Analyzed
5	Small isolation failure - failure-to-seal (Type C test)	Not Analyzed	Not Analyzed	Not Analyzed
6	Containment Isolation Failures (dependent failures, personnel errors)	35	5.99E+07	Ratio from class 1 baseline
7	Severe Accident Phenomena Induced Failure (early and late failures)	280	4.79E+08	Ratio from class 1 baseline
8	Containment Bypassed (SGTR / ISLOCA)	-	4.50E+08	No credit for containment

The above results when combined with the frequencies presented in Table G2-2 yields the Beaver Valley Unit 2 baseline mean consequence measures (risks, in terms of person-rem/yr) for each accident class. The resulting risks (in terms of person-rem/yr), for each accident class, are presented in Table G2-6 below.

Table G2-6
Beaver Valley Unit 2 Mean Baseline Risk - for Accident Classes

Class	Description	Frequency (per Rx-yr)	Person-Rem (50-Miles)	Person-Rem/yr (50-Miles)
1	No Containment Failure	5.22E-06	1.71E+05	8.93E-01
2	Large Isolation Failures (failure to close)	2.16E-09	1.71E+08	3.69E-01
3A	Small Pre-existing Containment Leak	1.50E-07	4.28E+06	6.43E-01
3B	Large Pre-existing Containment Leak	9.02E-10	1.71E+08	1.54E-01
4	Small Isolation Failure to Seal (Type B Test)	Not Analyzed	Not Analyzed	Not Analyzed
5	Small Isolation Failure to Seal (Type C Test)	Not Analyzed	Not Analyzed	Not Analyzed
6	Other Isolation Failures (e.g., dependent failures)	5.43E-08	5.99E+07	3.25E+00
7	Failure Induced by Phenomena (early and late failures)	7.27E-06	4.79E+08	3.48E+03
8	Bypass (SGTR / ISLOCA)	3.75E-06	4.50E+08	1.69E+03
Total	All CET End States	1.64E-05	N/A	5173.68

N/A is Not Applicable

Based on the above values, the percent risk contribution associated with the "intact" containment sequences for Class 1 and Class 3 ($\%Risk_{BASE}$) is as follows:

$\%Risk_{BASE} = [(Risk_{Class\ 1\ BASE} + Risk_{Class\ 3A\ BASE} + Risk_{Class\ 3B\ BASE}) / Total_{BASE}] \times 100$

Where:

$Risk_{Class\ 1\ BASE}$ = Class 1 person-rem/yr = 8.93E-01 person-rem/yr [Table G2-6]

$Risk_{Class\ 3A\ BASE}$ = Class 3A person-rem/yr = 6.43E-01 person-rem/yr [Table G2-6]

$Risk_{Class\ 3B\ BASE}$ = Class 3B person-rem/yr = 1.54E-01 person-rem/yr [Table G2-6]

$Total_{BASE}$ = total dose/year for baseline interval = 5173.68 person-rem/year [Table G2-6]

$\%Risk_{BASE} = [(8.93E-01 + 6.43E-01 + 1.54E-01) / 5173.68] \times 100$

$\%Risk_{BASE} = 0.033\ \%$

Therefore, the total baseline risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.033 %.

G2.2.3 Risk Impact of Extending Type A Test Interval From 10 To 15 And 20 Years

Using the methodology described in the main report that was used above to determine baseline risk values (see Table G2-6), the risk values were determined for the Current 10 year ILRT test interval, a 15 year ILRT test interval, and a 20 year ILRT test interval. These risk values are presented below in Table G2-7.

Table G2-7
Beaver Valley Unit 2 Risk Values vs ILRT Interval (Person-Rem/yr to 50-Miles)

Class	Description	Current 10 year ILRT interval	15 year ILRT interval	20 year ILRT interval
1	No Containment Failure	8.41E-01	8.02E-01	7.63E-01
2	Large Isolation Failures (failure to close)	3.69E-01	3.69E-01	3.69E-01
3A	Small Pre-existing Containment Leak	1.93E+00	2.89E+00	3.86E+00
3B	Large Pre-existing Containment Leak	4.63E-01	6.94E-01	9.26E-01
4	Small Isolation Failure to Seal (Type B Test)	Not Analyzed	Not Analyzed	Not Analyzed
5	Small Isolation Failure to Seal (Type C Test)	Not Analyzed	Not Analyzed	Not Analyzed
6	Other Isolation Failures (e.g., dependent failures)	3.25E+00	3.25E+00	3.25E+00
7	Failure Induced by Phenomena (early and late failures)	3.48E+03	3.48E+03	3.48E+03
8	Bypass (SGTR/ISLOCA)	1.69E+03	1.69E+03	1.69E+03
Total	All CET End States	5175.23	5176.38	5177.54

Based on the above values, and using the methodology described in the main report, the percent risk contribution ($\%Risk_N$, for values of N of 10, 15 and 20 years) for Class 1 and Class 3 is determined and yields the results summarized in Table G2-8, below. Also, the percent change in risk due to ILRT interval extensions is determined and presented in Table G2-8.

Table G2-8
Beaver Valley Unit 2 Percent Risk Increases from ILRT Interval Extensions

	Description	Current 10 year ILRT interval	15 year ILRT interval	20 year ILRT interval
$\%Risk_N$	Percent risk contribution for Class 1 and Class 3	0.062%	0.085%	0.107%
$\Delta\%Risk_{\text{Base to N}}$	Percent increase in total risk due to an N-year ILRT over the baseline case	0.03%	N/A	N/A
$\Delta\%Risk_{10\text{-}N}$	Percent increase in risk due to an N-year ILRT over the 10 year case	N/A	0.02%	0.04%

G2.2.4 Change In Risk In Terms Of Large Early Release Frequency (LERF)

Section 5.2.4 of the main body of this report discusses the quantification of LERF. This analysis assumes that Class 2, 3B, 6, 7 and 8 lead to large leak rates. The baseline LERF frequency, for the 3 in 10 year inspection interval, is determined as shown in Table G2-9. The estimate for Class 7 includes only the portion of Class 7 identified in the PSA as representing early containment failure.

Table G2-9
Beaver Valley Unit 2 Baseline LERF Frequency Calculation

Class	Description	LERF
2	Large Isolation Failures (failure to close)	2.16E-09
3B	Large Pre-existing Containment Leak	9.02E-10
6	Other Isolation Failures (e.g., dependent failures)	5.43E-08
7 (Early)	Failure Induced by Phenomena (early failures)	5.06E-07
8	Bypass (SGTR / ISLOCA)	3.75E-06
LERF	(total)	**4.3136E-06**

<u>Impact of ILRT Test Interval Extensions on Large Early Release Frequency (LERF)</u>

Table G2-10 presents the frequencies for each large release class, for each of four ILRT intervals. The total LERFs are also listed, along with the increase in LERF from the current LERF, and the percent increase from the current LERF.

As the only class contributor to the change in large early release is due to Class 3B events, the $\Delta LERF = F_{\text{Class 3B}}$ (evaluated at the new inspection interval) – $F_{\text{Class 3B}}$ (of the baseline interval or the current interval, as appropriate).

The percent change in LERF is calculated as:

$$\%\Delta LERF = [\Delta LERF/LERF_{Total}] \times 100$$

Where:
$LERF_{Total}$ = The sum of the Frequencies of Sequences 2, 3B, 6, 8, and the "early" portion of Class 7, (5.06E-07).

Table G2-10
Beaver Valley Unit 2 LERF Variation as a Function of Change in Inspection Interval

Class	Description	3 per 10 Years	10 Years	15 Years	20 Years
2	Large Isolation Failures (failure to close)	2.16E-09	2.16E-09	2.16E-09	2.16E-09
3B	Large Pre-existing Containment Leak	9.02E-10	2.71E-09	4.06E-09	5.41E-09
6	Other Isolation Failures (e.g., dependent failures)	5.43E-08	5.43E-08	5.43E-08	5.43E-08
7 (Early)	Failure Induced by Phenomena (early failures)	5.06E-07	5.06E-07	5.06E-07	5.06E-07
8	Bypass (SGTR)	3.75E-06	3.75E-06	3.75E-06	3.75E-06
LERF	Total	4.3136E-06	4.3154E-06	4.3167E-06	4.3181E-06
ΔLERF	Increase from Current LERF	N/A	0.0	1.353E-09	2.707E-09
%ΔLERF	% Increase from Current LERF	N/A	0.0%	0.03%	0.06%

G3.0 SUMMARY OF RESULTS

<u>Baseline ILRT Interval Results</u> (For this evaluation, the baseline risk contribution is taken as the original inspection interval at the time that the Beaver Valley Unit 2 PRA Model (BV2 Rev. 3A, January 2002) was done; that is, three inspections per 10 year interval)

1. The baseline risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.033 % of total risk.

2. The baseline LERF is 4.3136E-06 per year.

<u>Ten Year ILRT Interval Results</u>

1. The current Type A 10-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.062 % of total risk.

2. The increase in total risk from extending the ILRT test interval from the baseline interval to current 10 year interval is 0.03 %.

3. The LERF with a 10 year ILRT interval is 4.3154E-06 per year.

4. The increase in LERF from extending the ILRT test interval from the baseline interval to the current 10 year interval is 1.805E-09 per year.

5. The % increase in LERF from extending the ILRT test interval from the baseline interval to 10 years is 0.04 %. Since the CDF is not changed as a result of the extended ILRT interval, the increase in LERF is due only to the small increase (0.04 %) in conditional containment unreliability.

<u>Fifteen Year ILRT Interval Results</u>

1. Type A 15-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.085 % of total risk.

2. The increase in total risk from extending the ILRT test interval from the current 10 year interval to 15 years is 0.02 %.

3. The LERF for the 15 year interval is 4.3167E-06 per year.

4. The increase in LERF from extending the ILRT test interval from the 10 year interval to 15 years is 1.353E-09 per year.

5. The % increase in LERF from extending the ILRT test interval from the 10 year interval to 15 years is 0.03%. Since the CDF is not changed as a result of the extended ILRT

interval, the increase in LERF is due only to the small increase (0.03%) in conditional containment unreliability.

Twenty Year ILRT Interval Results

1. Type A 20-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios 0.107 % of total risk.

2. The increase in total risk from extending the ILRT test interval from the current 10 year interval to 20 years is 0.04 %.

3. The LERF for the 20 year interval is 4.3181E-06 per year.

4. The increase in LERF from extending the ILRT test interval from the 10 year interval to 20 years is 2.707E-09 per year.

5. The % increase in LERF from extending the ILRT test interval from the 10 year interval to 20 years is 0.06%. Since the CDF is not changed as a result of the extended ILRT interval, the increase in LERF is due only to the small increase (0.06%) in conditional containment unreliability.

G4.0 REFERENCES

G-1 Beaver Valley Unit 2 PRA Model (BV2 Rev. 3A, January 2002).

G-2 NEI 94-01, Revision 0 "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50," Appendix J, July 26, 1995.

G-3 EPRI TR-104285, "Risk Assessment of Revised Containment Leak Rate Testing Intervals," August 1994.

G-4 Beaver Valley Unit 2 UFSAR, Rev 12.

G-5 NUREG/CR-6604, Supplement 1, RADTRAD: A Simplified Model for RADionuclide Transport And Dose estimation, SNL, Bixler, N.E. et al, June 1999.

G-6 Regulatory Guide 1.163.

ENCLOSURE 4
Sensitivity Evaluation Comparing the CEOG JAR Methodology with an Alternate Previously Approved Methodology for Beaver Valley Unit 1

SENSITIVITY EVALUATION COMPARING THE CEOG JAR METHODOLOGY WITH AN ALTERNATE PREVIOUSLY APPROVED METHODOLOGY FOR BEAVER VALLEY UNIT 1

The FENOC submittal references the Combustion Engineering Owners Group (CEOG) Joint Applications Report (JAR) (Reference 1) for the supporting technical justification for the request of a one-time extension of the Integrated Leak Rate Test (ILRT) interval to 15 years.

The purpose of this report is to present a plant-specific analysis using a methodology similar to that already approved for the Crystal River 3 (CR3) application (Reference 2). Note that FENOC believes the methodology applied in the CEOG JAR to be reasonable and consistent with good practice in risk-informed evaluations. The results of the CEOG evaluation, which represents the use of a best-estimate approach to establish the probability of the small isolation failures of interest, demonstrates an even better risk justification of the request. The previously approved methodology utilizes a 95th percentile estimate of the probability of the small isolation events and the results reflect a somewhat greater impact of the change on overall risk. Other differences between the methodologies will be described in the body of the evaluation below. The change is demonstrated to be risk insignificant in both methodologies.

Both of the methodologies followed the same general approach to the evaluation of the risk of the interval extension. There were differences in the approaches, in the assumptions, and in the development of a probability estimate for the release class 3 events. The methodologies:

- Both utilize the EPRI TR-104285 (Reference 3) release classes to categorize the various containment failure scenarios.
- Both establish the plant-specific frequencies for each EPRI release class.
- Both define estimated leakage for each release class.
- Both quantify the risk for each release class by multiplying the class frequency times the assumed leakage.
- Both evaluated a baseline case (3 tests in 10 years), a current case (1 test in 10 years), and the proposed case (1 test in 15 years).

Table 1 summarizes the treatment of each of the EPRI Release Classes and provides a summary of some of the differences between the CEOG JAR and the CR3 methodologies.

Table 1
EPRI Release Class Definitions

Release Class	Description	CR3 Submittal	CEOG JAR
1	No containment failure	Frequency reduced as Class 3 increases; leakage magnitude increases to 2 L_a	Frequency reduced with Class 3 increase; considered leakage of L_a
2	Large isolation failures	No change from baseline consequence measures; considered leakage of 35 L_a	No change from baseline consequence measures; considered leakage of 1000 L_a
3	Isolation failures	3a: small leaks, 10 L_a, non-LERF 3b: large leaks, 35 L_a, LERF Probability derived using 95th %-ile χ^2 distribution of NUREG-1493 data	3a: small leaks, 25 L_a, non-LERF 3b: large leaks, 1000 L_a, LERF Probability derived using log-normal distribution of NUREG-1493 data
4,5	Other small isolation failures (LLRT)	No change from baseline consequence measures; not analyzed	No change from baseline consequence measures; not analyzed
6	Other isolation failures	No change from baseline consequence measures; considered leakage of 35 L_a	No change from baseline consequence measures; considered leakage of 350 L_a
7	Induced failures	No change from baseline consequence measures; considered leakage of 100 L_a	No change from baseline consequence measures; considered leakage of 2800 L_a
8	Bypass	Characterized by SGTR scenario – not impacted by ILRT extension	Characterized by SGTR and ISLOCA – not impacted by ILRT extension

Evaluation of Baseline ILRT Interval

The plant-specific evaluation of risk for the baseline case ILRT interval for Beaver Valley Unit 1 is presented in Table 2. The release frequencies for the Class 2, 6, 7, and 8 bins are taken from the CEOG JAR, which had compiled these data based on the Beaver Valley Unit 1 PRA Model (BV1 Rev. 2, June 1998). As noted in Table 1, the risk associated with the Class 4 and 5 bins is not impacted by the ILRT interval and is not analyzed here. The release frequencies for the Class 3a and 3b bins are determined based on the previously approved methodology (see next paragraph). The release frequency for Class 1 is the value of core damage frequency (CDF) reduced by the frequencies of the Class 3a and 3b scenarios. (Note – the CEOG JAR had utilized a value of CDF representative of sequences in which the containment remains intact. This value was approximately 9% of total CDF. The previously approved methodology used total CDF. Total CDF will be used in this plant-specific evaluation.)

The Class 3a and 3b frequencies in the previously approved methodology were determined based on a 95th percentile χ^2 distribution of the NUREG-1493 data. For the baseline ILRT interval (3 tests in 10 years), this resulted in a frequency for Class 3a of

0.064 (Reference 4) times CDF and a frequency for Class 3b of 0.021 (Reference 5) times CDF. These frequencies are used in the Beaver Valley Unit 1 evaluation presented in Table 2. Note the total CDF for Beaver Valley Unit 1 is 8.50E-05 per year and the intact containment release frequency is 7.59E-06 per year based on the Beaver Valley Unit 1 PRA Model (BV1 Rev. 2, June 1998).

Table 2
Beaver Valley Unit 1 Risk Evaluation of Baseline ILRT Interval

Class	Frequency (per reactor-year)	Release (person-rem)	Risk (person-rem/year)
1	FREQ(intact)-FREQ(3a)-FREQ(3b) = 3.68E-07 (Reference 7)	L_a = 1.71E+05 (Reference 6)	0.06
2	1.19E-08	35 L_a = 5.99E+06	0.07
3a	0.064 x CDF = 5.44E-06	10 L_a = 1.71E+06	9.30
3b	0.021 x CDF = 1.78E-06	35 L_a = 5.99E+06	10.68
6	1.11E-05	35 L_a = 5.99E+06	66.43
7	5.98E-05	100 L_a = 1.71E+07	1022.58
8	6.54E-06	4.50E+08 (Reference 6)	2943.00
		Total Risk	4052.13

In the CEOG JAR, a risk contribution of the intact containment sequences (i.e., Classes 1, 3a, and 3b) was determined. Using the previously approved methodology, the risk contribution due to the ILRT Type A testing was considered to be due to the Class 3a and 3b scenarios. From Table 2, it can be seen that the risk contribution associated with the ILRT testing interval considering Classes 3a and 3b is:

$$\% \text{ Risk} = [(\text{Risk}_{\text{Class 3a}} + \text{Risk}_{\text{Class 3b}}) / \text{Total Risk}] \times 100$$

$$= [(9.30 + 10.68) / 4052.13] \times 100$$

$$= 0.49\%$$

In the CEOG JAR, it was also assumed that the Class 2, 3b, 6, 8, and the early Class 7 scenarios could lead to large early releases and thus, contribute to large early release frequency (LERF). The previously approved methodology focused only on the Class 3b scenario, which is the only one affected by the consideration of the ILRT interval. As the parameter of concern in the evaluation is ΔLERF, and because Class 3b is the only class affected by the interval extension, ΔLERF is compared on a consistent basis in both methodologies. Thus, for this evaluation the baseline LERF is the Class 3b frequency, or 1.78E-06 per year.

Risk Evaluation of the Current ILRT Interval (1 in 10 years)

This evaluation of the 'once in 10 years' interval will be performed using the same approach as taken above for the baseline case. The frequencies for all release classes, except Class 1, 3a, and 3b, are unaffected by the change in the interval and remain as in Table 2. And the releases for all of the classes are the same as those shown in Table 2 for the baseline case.

The increased probability of not detecting excessive leakage in a Type A test directly impacts the frequencies of the Class 3 events. Based on the previously approved methodology, the Class 3a and 3b frequencies are determined by simply multiplying the baseline frequency by a factor of 1.1. With this change in the Class 3 frequencies, the Class 1 frequency is also adjusted to preserve the total CDF. The evaluation of the current interval is presented in Table 3.

Table 3
Beaver Valley Unit 1 Risk Evaluation
of Current ILRT Interval

Class	Frequency (per reactor-year)	Release (person-rem)	Risk (person-rem/year)
1	FREQ(intact)-FREQ(3a)-FREQ(3b) = 0.00E-00 (Reference 7) (Note 1)	L_a = 1.71E+05 (Reference 6)	0.00
2	1.19E-08	35 L_a = 5.99E+06	0.07
3a	1.1 x 0.064 x CDF = 5.98E-06	10 L_a = 1.71E+06	10.23
3b	1.1 x 0.021 x CDF = 1.96E-06	35 L_a = 5.99E+06	11.75
6	1.11E-05	35 L_a = 5.99E+06	66.43
7	5.98E-05	100 L_a = 1.71E+07	1022.58
8	6.54E-06	4.50E+08 (Reference 6)	2943.00
		Total Risk	4054.07

Note 1 – Application of the methodology in Reference 7 to Beaver Valley Unit 1 results in a slightly negative frequency for Class 1, interpreted here as zero. This results from the fact the Beaver Valley Unit 1 PRA Model (BV1 Rev. 2, June 1998) estimates that only 9% of the core damage events result in intact containment as compared to 29% for the plant in Reference 7. This has no impact on the LERF estimates and a negligible impact on risk estimates.

As was noted above for the baseline evaluation:

- the risk contribution due to the Type A test interval is [(10.23 + 11.75) / 4054.07] x 100, or 0.54%.
- the LERF for the current interval evaluation is the Class 3b frequency, or 1.96E-06 per year.

Risk Evaluation of the Proposed ILRT Interval (1 in 15 years, one-time)

This evaluation of the 'once in 15 years' interval will be performed using the same approach as taken above for the baseline case. The frequencies for all release classes, except Class 1, 3a, and 3b, are unaffected by the change in the interval and remain as in Table 2. And the releases for all of the classes are the same as those shown in Table 2 for the baseline case.

The increased probability of not detecting excessive leakage in a Type A test directly impacts the frequencies of the Class 3 events. Based on the previously approved methodology, the Class 3a and 3b frequencies are determined by simply multiplying the baseline frequency by a factor of 1.15. With this change in the Class 3 frequencies, the Class 1 frequency is also adjusted to preserve the total CDF. The evaluation of the current interval is presented in Table 4.

Table 4
Beaver Valley Unit 1 Risk Evaluation
of Proposed ILRT Interval

Class	Frequency (per reactor-year)	Release (person-rem)	Risk (person-rem/year)
1	FREQ(intact)-FREQ(3a)-FREQ(3b) = 0.00E-00 (Reference 7) (Note 1)	L_a = 1.71E+05 (Reference 6)	0.00
2	1.19E-08	35 L_a = 5.99E+06	0.07
3a	1.15 x 0.064 x CDF = 6.26E-06	10 L_a = 1.71E+06	10.70
3b	1.15 x 0.021 x CDF = 2.05E-06	35 L_a = 5.99E+06	12.29
6	1.11E-05	35 L_a = 5.99E+06	66.43
7	5.98E-05	100 L_a = 1.71E+07	1022.58
8	6.54E-06	4.50E+08 (Reference 6)	2943.00
		Total Risk	4055.07

Note 1 – Application of the methodology in Reference 7 to Beaver Valley Unit 1 results in a slightly negative frequency for Class 1, interpreted here as zero. This results from the fact the Beaver Valley Unit 1 PRA Model (BV1 Rev. 2, June 1998) estimates that only 9% of the core damage events result in intact containment as compared to 29% for the plant in Reference 7. This has no impact on the LERF estimates and a negligible impact on risk estimates.

As was noted above for the baseline evaluation:

- the risk contribution due to the Type A test interval is [(10.70 + 12.29) / 4055.07] x 100, or 0.57%.
- the LERF for the current interval evaluation is the Class 3b frequency, or 2.05E-06 per year.

Conditional Containment Failure Probability

Another parameter of interest in evaluating the risk impact of a change to the ILRT interval is the conditional containment failure probability (CCFP). In the CEOG JAR methodology, ΔLERF was considered to be directly related to ΔCCFP. The results using that approach were a ΔCCFP of 0.01% due to the proposed interval compared to the current interval, and 0.02% due to the change to the proposed interval compared to the baseline case. In the previously approved methodology, CCFP was defined as:

CCFP = 1 – (frequency of no containment failure sequences / CDF)

Further, the sequences representing no containment failure were considered to be the Class 1 and 3a events. As can be seen in Tables 2, 3 and 4, the only Containment Class that represents containment failure and that changes as a function of ILRT interval is Class 3b. Thus the change in conditional containment failure probability, ΔCCFP, can be derived using the Class 3b frequencies from Tables 2, 3, and 4. The ΔCCFP between the current ILRT interval and the proposed ILRT interval may be derived by:

$$\Delta CCFP_{c\ to\ p} = \{[freq\ (Cl3b)]_p - [freq\ (Cl3b)]_c\} / CDF$$

$$= \{[2.05E-06] - [1.96E-06]\} / 8.50E-05$$

$$= 0.0011, \text{ or } 0.11\%$$

Similarly, the impact of the proposed ILRT interval compared with the baseline ILRT interval is given by:

$$\Delta CCFP_{b\ to\ p} = \{[freq\ (Cl3b)]_p - [freq\ (Cl3b)]_b\} / CDF$$

$$= \{[2.05E-06] - [1.78E-06\} / 8.50E-05$$

$$= 0.0032, \text{ or } 0.32\%$$

Summary

A summary of the risk evaluation of the ILRT interval changes using the previously approved methodology is presented in Table 5.

Regulatory Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Regulatory Guide 1.174 defines very small changes in risk as resulting in increases of CDF below 1E-06/year and increases in LERF below 1E-07/year. Since the ILRT does not impact CDF, the relevant metric is LERF. Calculating the increase in LERF involves determining the impact of the ILRT interval on the leakage probability.

Table 5
Summary of Results of ILRT Interval Risk Evaluation (Using Previously Approved Approach)

ILRT Interval	ILRT Risk Contribution	LERF (per year)	ΔLERF from baseline (per year)	ΔLERF from current (per year)
baseline (3 in 10 years)	0.49%	1.78E-06	—	—
current (1 in 10 years)	0.54%	1.96E-06	1.78E-07	—
proposed (1 in 15 years)	0.57%	2.05E-06	2.68E-07	8.92E-08

For comparison purposes, the evaluation results from the CEOG JAR, derived using differences in assumptions and methodology, are presented in Table 6

Table 6
Summary of Results of ILRT Interval Risk Evaluation (using CEOG JAR approach)

ILRT Interval	ILRT Risk Contribution	LERF	ΔLERF from baseline	ΔLERF from current
baseline (3 in 10 years)	0.007%	1.8247E-05	—	—
current (1 in 10 years)	0.014%	1.8250E-05	2.551E-09	—
proposed (1 in 15 years)	0.019%	1.8252E-05	4.465E-09	1.914E-09

Conclusion

The risk associated with extending the ILRT interval is quantifiable. FENOC has utilized two alternate methodologies to quantify the risk and evaluate the proposed change in the ILRT interval to 15 years. Both methodologies demonstrate the risk associated with the extension of the interval is small. On this basis, FENOC requests approval of a one-time extension of the Beaver Valley Unit 1 ILRT interval to 15 years.

References

1. WCAP-15691, Revision 4, "Joint Applications Report for Containment Integrated Leak Rate Test Interval Extension," September 2002.
2. FPC Letter to USNRC, 3F0601-06, June 20, 2001, Crystal River-Unit 3 – License Amendment Request #267, Revision 2, "Supplemental Risk-Informed Information in Support of License Amendment Request #267".
3. EPRI TR-104285, "Risk Impact Assessment of Revised Containment Leak Rate Testing Interval," August 1994.
4. FPC Calculation F-01-0001, Revision 2, Evaluation of Risk Significance of ILRT Extension, page 12
5. FPC Calculation F-01-0001, Revision 2, Evaluation of Risk Significance of ILRT Extension, page 11
6. WCAP-15691 Revision 4, Appendix F, Table F2-6
7. FPC Calculation F-01-0001, Revision 2, Evaluation of Risk Significance of ILRT Extension, page 13

ENCLOSURE 5
Sensitivity Evaluation Comparing the CEOG JAR Methodology with an Alternate Previously Approved Methodology for Beaver Valley Unit 2

SENSITIVITY EVALUATION COMPARING THE CEOG JAR METHODOLOGY WITH AN ALTERNATE PREVIOUSLY APPROVED METHODOLOGY FOR BEAVER VALLEY UNIT 2

The FENOC submittal references the Combustion Engineering Owners Group (CEOG) Joint Applications Report (JAR) (Reference 1) for the supporting technical justification for the request of a one-time extension of the Integrated Leak Rate Test (ILRT) interval to 15 years.

The purpose of this report is to present a plant-specific analysis using a methodology similar to that already approved for the Crystal River 3 (CR3) application (Reference 2). Note that FENOC believes the methodology applied in the CEOG JAR to be reasonable and consistent with good practice in risk-informed evaluations. The results of the CEOG evaluation, which represents the use of a best-estimate approach to establish the probability of the small isolation failures of interest, demonstrates an even better risk justification of the request. The previously approved methodology utilizes a 95th percentile estimate of the probability of the small isolation events and the results reflect a somewhat greater impact of the change on overall risk. Other differences between the methodologies will be described in the body of the evaluation below. The change is demonstrated to be risk insignificant in both methodologies.

Both of the methodologies followed the same general approach to the evaluation of the risk of the interval extension. There were differences in the approaches, in the assumptions, and in the development of a probability estimate for the release class 3 events. The methodologies:

- Both utilize the EPRI TR-104285 (Reference 3) release classes to categorize the various containment failure scenarios.
- Both establish the plant-specific frequencies for each EPRI release class.
- Both define estimated leakage for each release class.
- Both quantify the risk for each release class by multiplying the class frequency times the assumed leakage.
- Both evaluated a baseline case (3 tests in 10 years), a current case (1 test in 10 years), and the proposed case (1 test in 15 years).

Table 1 summarizes the treatment of each of the EPRI Release Classes and provides a summary of some of the differences between the CEOG JAR and the CR3 methodologies.

Table 1
EPRI Release Class Definitions

Release Class	Description	CR3 Submittal	CEOG JAR
1	No containment failure	Frequency reduced as Class 3 increases; leakage magnitude increases to 2 L_a	Frequency reduced with Class 3 increase; considered leakage of L_a
2	Large isolation failures	No change from baseline consequence measures; considered leakage of 35 L_a	No change from baseline consequence measures; considered leakage of 1000 L_a
3	Isolation failures	3a: small leaks, 10 L_a, non-LERF 3b: large leaks, 35 L_a, LERF Probability derived using 95th %-ile χ^2 distribution of NUREG-1493 data	3a: small leaks, 25 L_a, non-LERF 3b: large leaks, 1000 L_a, LERF Probability derived using log-normal distribution of NUREG-1493 data
4,5	Other small isolation failures (LLRT)	No change from baseline consequence measures; not analyzed	No change from baseline consequence measures; not analyzed
6	Other isolation failures	No change from baseline consequence measures; considered leakage of 35 L_a	No change from baseline consequence measures; considered leakage of 350 L_a
7	Induced failures	No change from baseline consequence measures; considered leakage of 100 L_a	No change from baseline consequence measures; considered leakage of 2800 L_a
8	Bypass	Characterized by SGTR scenario – not impacted by ILRT extension	Characterized by SGTR and ISLOCA – not impacted by ILRT extension

Evaluation of Baseline ILRT Interval

The plant-specific evaluation of risk for the baseline case ILRT interval for Beaver Valley Unit 2 is presented in Table 2. The release frequencies for the Class 2, 6, 7, and 8 bins are taken from the CEOG JAR, which had compiled these data based on the Beaver Valley Unit 2 PRA Model (BV2 Rev. 3A, January 2002). As noted in Table 1, the risk associated with the Class 4 and 5 bins is not impacted by the ILRT interval and is not analyzed here. The release frequencies for the Class 3a and 3b bins are determined based on the previously approved methodology (see next paragraph). The release frequency for Class 1 is the value of core damage frequency (CDF) reduced by the frequencies of the Class 3a and 3b scenarios. (Note – the CEOG JAR had utilized a value of CDF representative of sequences in which the containment remains intact. This value was approximately 33% of total CDF. The previously approved methodology used total CDF. Total CDF will be used in this plant-specific evaluation.)

The Class 3a and 3b frequencies in the previously approved methodology were determined based on a 95th percentile χ^2 distribution of the NUREG-1493 data. For the baseline ILRT interval (3 tests in 10 years), this resulted in a frequency for Class 3a of 0.064 (Reference 4) times CDF and a frequency for Class 3b of 0.021 (Reference 5) times CDF. These frequencies are used in the Beaver Valley Unit 2 evaluation presented in Table 2. Note the total CDF for Beaver Valley Unit 2 is 1.64E-05 per year and the intact containment release frequency is 5.37E-06 per year based on the Beaver Valley Unit 2 PRA Model (BV2 Rev. 3A, January 2002).

Table 2
Beaver Valley Unit 2 Risk Evaluation
of Baseline ILRT Interval

Class	Frequency (per reactor-year)	Release (person-rem)	Risk (person-rem/year)
1	FREQ(intact)-FREQ(3a)-FREQ(3b) = 3.98E-06 (Reference 7)	L_a = 1.71E+05 (Reference 6)	0.68
2	2.16E-09	35 L_a = 5.99E+06	0.01
3a	0.064 x CDF = 1.05E-06	10 L_a = 1.71E+06	1.79
3b	0.021 x CDF = 3.44E-07	35 L_a = 5.99E+06	2.06
6	5.43E-08	35 L_a = 5.99E+06	0.32
7	7.27E-06	100 L_a = 1.71E+07	124.32
8	3.75E-06	4.50E+08 (Reference 6)	1687.50
		Total Risk	1816.69

In the CEOG JAR, a risk contribution of the intact containment sequences (i.e., Classes 1, 3a, and 3b) was determined. Using the previously approved methodology, the risk contribution due to the ILRT Type A testing was considered to be due to the Class 3a and 3b scenarios. From Table 2, it can be seen that the risk contribution associated with the ILRT testing interval considering Classes 3a and 3b is:

$$\% \text{ Risk} = [(\text{Risk}_{\text{Class 3a}} + \text{Risk}_{\text{Class 3b}}) / \text{Total Risk}] \times 100$$

$$= [(1.79 + 2.06) / 1816.69] \times 100$$

$$= 0.21\%$$

In the CEOG JAR, it was also assumed that the Class 2, 3b, 6, 8, and the early Class 7 scenarios could lead to large early releases and thus, contribute to large early release frequency (LERF). The previously approved methodology focused only on the Class 3b scenario, which is the only one affected by the consideration of the ILRT interval. As the parameter of concern in the evaluation is ΔLERF, and because Class 3b is the only class affected by the interval extension, ΔLERF is compared on a consistent basis in both methodologies. Thus, for this evaluation the baseline LERF is the Class 3b frequency, or 3.44E-07 per year.

Risk Evaluation of the Current ILRT Interval (1 in 10 years)

This evaluation of the 'once in 10 years' interval will be performed using the same approach as taken above for the baseline case. The frequencies for all release classes, except Class 1, 3a, and 3b, are unaffected by the change in the interval and remain as in Table 2. And the releases for all of the classes are the same as those shown in Table 2 for the baseline case.

The increased probability of not detecting excessive leakage in a Type A test directly impacts the frequencies of the Class 3 events. Based on the previously approved methodology, the Class 3a and 3b frequencies are determined by simply multiplying the baseline frequency by a factor of 1.1. With this change in the Class 3 frequencies, the Class 1 frequency is also adjusted to preserve the total CDF. The evaluation of the current interval is presented in Table 3.

Table 3
Beaver Valley Unit 2 Risk Evaluation
of Current ILRT Interval

Class	Frequency (per reactor-year)	Release (person-rem)	Risk (person-rem/year)
1	FREQ(intact)-FREQ(3a)-FREQ(3b) = 3.84E-06 (Reference 7)	L_a = 1.71E+05 (Reference 6)	0.66
2	2.16E-09	35 L_a = 5.99E+06	0.01
3a	1.1 x 0.064 x CDF = 1.15E-06	10 L_a = 1.71E+06	1.97
3b	1.1 x 0.021 x CDF = 3.79E-07	35 L_a = 5.99E+06	2.27
6	5.43E-08	35 L_a = 5.99E+06	0.32
7	7.27E-06	100 L_a = 1.71E+07	124.32
8	3.75E-06	4.50E+08 (Reference 6)	1687.50
		Total Risk	1817.05

As was noted above for the baseline evaluation:

- the risk contribution due to the Type A test interval is [(1.97 + 2.27) / 1817.05] x 100, or 0.23%.
- the LERF for the current interval evaluation is the Class 3b frequency, or 3.79E-07 per year.

Risk Evaluation of the Proposed ILRT Interval (1 in 15 years, one-time)

This evaluation of the 'once in 15 years' interval will be performed using the same approach as taken above for the baseline case. The frequencies for all release classes, except Class 1, 3a, and 3b, are unaffected by the change in the interval and remain as in Table 2. And the releases for all of the classes are the same as those shown in Table 2 for the baseline case.

The increased probability of not detecting excessive leakage in a Type A test directly impacts the frequencies of the Class 3 events. Based on the previously approved methodology, the Class 3a and 3b frequencies are determined by simply multiplying the baseline frequency by a factor of 1.15. With this change in the Class 3 frequencies, the Class 1 frequency is also adjusted to preserve the total CDF. The evaluation of the current interval is presented in Table 4.

Table 4
Beaver Valley Unit 2 Risk Evaluation
of Proposed ILRT Interval

Class	Frequency (per reactor-year)	Release (person-rem)	Risk (person-rem/year)
1	FREQ(intact)-FREQ(3a)-FREQ(3b) = 3.77E-06 (Reference 7)	L_a = 1.71E+05 (Reference 6)	0.64
2	2.16E-09	35 L_a = 5.99E+06	0.01
3a	1.15 x 0.064 x CDF = 1.21E-06	10 L_a = 1.71E+06	2.06
3b	1.15 x 0.021 x CDF = 3.96E-07	35 L_a = 5.99E+06	2.37
6	5.43E-08	35 L_a = 5.99E+06	0.32
7	7.27E-06	100 L_a = 1.71E+07	124.32
8	3.75E-06	4.50E+08 (Reference 6)	1687.50
		Total Risk	1817.23

As was noted above for the baseline evaluation:

- the risk contribution due to the Type A test interval is [(2.06 + 2.37) / 1817.23] x 100, or 0.24%.
- the LERF for the current interval evaluation is the Class 3b frequency, or 3.96E-07 per year.

Conditional Containment Failure Probability

Another parameter of interest in evaluating the risk impact of a change to the ILRT interval is the conditional containment failure probability (CCFP). In the CEOG JAR methodology, ΔLERF was considered to be directly related to ΔCCFP. The results using that approach were a ΔCCFP of 0.03% due to the proposed interval compared to the current interval, and 0.07% due to the change to the proposed interval compared to the baseline case. In the previously approved methodology, CCFP was defined as:

$$CCFP = 1 - (\text{frequency of no containment failure sequences} / CDF)$$

Further, the sequences representing no containment failure were considered to be the Class 1 and 3a events. Thus, using this approach and the information from Tables 2, 3, and 4, the ΔCCFP between the current ILRT interval and the proposed ILRT interval may be derived by:

$$\Delta CCFP_{c\ to\ p} = \{[\text{freq (Cl1)} + \text{freq (Cl3a)}]_c - [\text{freq (Cl1)} + \text{freq (Cl3a)}]_p\} / CDF$$

$$= \{[3.838E\text{-}06 + 1.155E\text{-}06] - [3.768E\text{-}06 + 1.207E\text{-}06]\} / 1.64E\text{-}05$$

$$= 0.0011, \text{ or } 0.11\%$$

Similarly, the impact of the proposed ILRT interval compared with the baseline ILRT interval is given by:

$$\Delta CCFP_{b\ to\ p} = \{[\text{freq (Cl1)} + \text{freq (Cl3a)}]_b - [\text{freq (Cl1)} + \text{freq (Cl3a)}]_p\} / CDF$$

$$= \{[3.977E\text{-}06 + 1.050E\text{-}06] - [3.768E\text{-}06 + 1.207E\text{-}06]\} / 1.64E\text{-}05$$

$$= 0.0032, \text{ or } 0.32\%$$

Summary

A summary of the risk evaluation of the ILRT interval changes using the previously approved methodology is presented in Table 5.

Regulatory Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Regulatory Guide 1.174 defines very small changes in risk as resulting in increases of CDF below 1E-06/year and increases in LERF below 1E-07/year. Since the ILRT does not impact CDF, the relevant metric is LERF. Calculating the increase in LERF involves determining the impact of the ILRT interval on the leakage probability.

Table 5
Summary of Results of ILRT Interval
Risk Evaluation (Using Previously Approved Approach)

ILRT Interval	ILRT Risk Contribution	LERF (per year)	ΔLERF from baseline (per year)	ΔLERF from current (per year)
baseline (3 in 10 years)	0.21%	3.44E-07	—	—
current (1 in 10 years)	0.23%	3.79E-07	3.444E-08	—
proposed (1 in 15 years)	0.24%	3.96E-07	5.166E-08	1.722E-08

For comparison purposes, the evaluation results from the CEOG JAR, derived using differences in assumptions and methodology, are presented in Table 6

Table 6
Summary of Results of ILRT Interval
Risk Evaluation (using CEOG JAR approach)

ILRT Interval	ILRT Risk Contribution	LERF	ΔLERF from baseline	ΔLERF from current
baseline (3 in 10 years)	0.033%	4.3136E-06	—	—
current (1 in 10 years)	0.062%	4.3154E-06	1.805E-09	—
proposed (1 in 15 years)	0.085%	4.3167E-06	3.158E-09	1.353E-09

Conclusion

The risk associated with extending the ILRT interval is quantifiable. FENOC has utilized two alternate methodologies to quantify the risk and evaluate the proposed change in the ILRT interval to 15 years. Both methodologies demonstrate the risk associated with the extension of the interval is small. On this basis, FENOC requests approval of a one-time extension of the Beaver Valley Unit 2 ILRT interval to 15 years.

References

1. WCAP-15691, Revision 4, "Joint Applications Report for Containment Integrated Leak Rate Test Interval Extension," September 2002.

2. FPC Letter to USNRC, 3F0601-06, June 20, 2001, Crystal River-Unit 3 – License Amendment Request #267, Revision 2, "Supplemental Risk-Informed Information in Support of License Amendment Request #267".

3. EPRI TR-104285, "Risk Impact Assessment of Revised Containment Leak Rate Testing Interval," August 1994.

4. FPC Calculation F-01-0001, Revision 2, Evaluation of Risk Significance of ILRT Extension, page 12

5. FPC Calculation F-01-0001, Revision 2, Evaluation of Risk Significance of ILRT Extension, page 11

6. WCAP-15691 Revision 4, Appendix G, Table G2-6

7. FPC Calculation F-01-0001, Revision 2, Evaluation of Risk Significance of ILRT Extension, page 13